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13. ABSTRACT *(Maximum 200 Words)*
The EIS was prepared to analyze the potential environmental consequences of the Proposed Action and No-Action Alternative. The Proposed Action is to allow the addition of up to five strap-on solid rocket motors (SRMs) to the Lockheed Martin Corporation (LMC) Atlas V Launch vehicle and to allow the use of larger SRMs on the Boeing Delta IV launch vehicle, both of which are part of the EELV program. The launch locations for the Atlas V and Delta IV systems are Cape Canaveral Air Force Station in Brevard County, Florida, and Vandenberg Air Force Base, in Santa Barbara County, California. For the analysis of the FSEIS, each contractor is assumed to launch approximately 50 percent of EELV flights involving SRMs (approximately 30 launches per year total). The No-Action Alternative is the previously approved implementation of the EELV program that was analyzed in the 1998 FEIS.

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FINAL

Supplemental Environmental Impact Statement

for the

Evolved Expendable Launch Vehicle Program

ENOVARUM PRAESTARUM
(Affordability Through Innovation)

March 2000

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FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

EVOLVED EXPENDABLE LAUNCH VEHICLE PROGRAM

a. Responsible Agency: U.S. Air Force

b. Cooperating Agencies: Federal Aviation Administration (FAA)
National Aeronautics and Space Administration (NASA)

c. Proposed Action: To allow the addition of up to five strap-on solid rocket motors (SRMs) to the Atlas V lift vehicle and to allow the use of larger SRMs on the Delta IV lift vehicle. Both vehicles are part of the Evolved Expendable Launch Vehicle (EELV) program.

d. Inquiries on this document should be directed to: Mr. Jonathan D. Farthing, Chief, Environmental Analysis Division, HQ AFCEE/ECA, 3207 North Road, Brooks Air Force Base, Texas, 78235-5363, (210) 536-3668, facsimile number (210) 536-3890.

e. Designation: Final Supplemental Environmental Impact Statement (FSEIS)

f. Abstract: This FSEIS has been prepared in accordance with the National Environmental Policy Act (NEPA). Implementation of the EELV program was previously assessed in the April 1998 *Final Environmental Impact Statement, Evolved Expendable Launch Vehicle Program.* The Proposed Action of this FSEIS is to allow the addition of up to five strap-on SRMs to the Lockheed Martin Corporation (LMC) Atlas V launch vehicle and to allow the use of larger SRMs on the Boeing Delta IV launch vehicle, both of which are part of the EELV program. The launch locations for the Atlas V and Delta IV systems are Cape Canaveral Air Force Station in Brevard County, Florida, and Vandenberg Air Force Base, in Santa Barbara County, California. For the analysis in the FSEIS, each contractor is assumed to launch approximately 50 percent of EELV flights involving SRMs (approximately 30 launches per year total). The No-Action Alternative is the previously approved implementation of the EELV program that was analyzed in the 1998 FEIS.

The FSEIS analyzes potential impacts to the local community, land use and aesthetics, transportation, utilities, hazardous materials and hazardous waste management, health and safety, geology and soils, water resources, air quality (upper and lower atmosphere), noise, orbital debris, biological resources, cultural resources, and environmental justice.

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Acronyms/Abbreviations

A-50	Aerozine-50
AAGTO	Annually averaged global total ozone
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFI	Air Force Instruction
AFOSH	Air Force Office of Safety and Health
AFSPC	Air Force Space Command
AGL	Above ground level
Al	Aluminum
Al_2O_3	Aluminum oxide
	Health Directorate
AOC	Area of concern
ASOC	Atlas V Spaceflight Operations Center
AST	Office of the Associate Administrator for Commercial Space Transportation
AWSPL	A-weighted sound pressure level
BAB	Booster assembly building
BO	Biological opinion
Boeing	McDonnell Douglas Corporation, a wholly owned subsidiary of the Boeing Company
CAA	Clean Air Act, as amended in 1990
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CBC	Common booster core
CCAFS	Cape Canaveral Air Force Station
CCSI	California Commercial Spaceport, Inc.
CCB	Common Core Booster™
CCR	California Code of Regulations
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
Cl_2	Chlorine
ClO	Chlorine oxide
CO	Carbon monoxide
CO_2	Carbon dioxide
COMSTAC	Commercial Space Transportation Advisory Committee
CPF	Centaur Processing Facility
CPT	Centerline carpet boom
CP2	Carpet boom at a position of ½ CPT overpressure level
CSA	California Space Authority

CUS	Cryogenic upper stage
CWA	Clean Water Act
CZMP	Coastal Zone Management Program
dB	Decibel
DCUS	Delta Cryogenic Upper Stage
DIV	Delta IV
DIV H	Delta IV Delta IV Heavy launch vehicle
DIV M	Delta IV Medium launch vehicle
DIV M+	Delta IV Medium launch vehicle with solid rocket motor strap-ons
DOC	Delta IV Operations Center
DoD	U.S. Department of Defense
DOT	U. S. Department of Transportation
DPF	DSCS Processing Facility
DSCS	Defense Satellite Communications System
DSEIS	Draft Supplemental Environmental Impact Statement
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
EA	Environmental Assessment
EC	Expected casualties
ECMP	Environmental Compliance Management Plan
EDG	Focus boom at the carpet edge
EELV	Evolved Expendable Launch Vehicle
EFH	Essential fish habitat
EOD	Explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
EPCRA	Environmental Planning and Community Right-to-Know Act
ERDAS	Eastern Range Dispersion Assessment System
ESQD	Explosive Safety Quantity-Distance
EWR	Eastern and Western Range
FAA	Federal Aviation Administration
FAAQS	Florida Ambient Air Quality Standards
FAC	Florida Administrative Code
FCMA	Florida Coastal Management Act
FCMP	Florida Coastal Management Plan
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FIP	Federal Implementation Plan
FMC	Fishery Management Council
FMS	Fabricate, modify, small hardware
FOC	Focus boom on centerline
FONPA	Finding of No Practicable Alternatives
FONSI	Finding of No Significant Impact
FSEIS	Final Supplemental Environmental Impact Statement
FTS	Flight termination system
GEM	Graphite epoxy motor
GSO	Geostationary orbit
GTO	Geosynchronous transfer orbit

HABS/HAER Record	Historic American Building Survey/Historic American Engineering
HCFCs	Hydrochlorofluorocarbons
HCl	Hydrogen chloride
HDCUS	Heavy Delta Cryogenic Upper Stage
He	Helium
HIF	Horizontal Integration Facility
HLV	Heavy-lift vehicle
HNO_3	Nitric acid
HQ AFSPC/SG	Headquarters Air Force Space Command/Surgeon General
HTPB	Hydroxyl-terminated polybutadiene
HUS	Hypergolic Upper Stage
HVAC	Heating, ventilation, and air conditioning
HWMP	Hazardous Waste Management Plan
HYPACT	Hybrid Particle and Concentration Transport
ICBM	Intercontinental Ballistic Missile
IDLH	Immediately Dangerous to Life and Health
Inv.	Inversion
IPF	Integrated Processing Facility
IPS	Ignition pulse suppression
IRP	Installation Restoration Program
ITL	Integrate Transfer Launch
JANNAF	Joint Army-Navy-NASA-Air Force
KSC	Kennedy Space Center
LATRA	Launch Area Toxic Risk Analysis
lbs	Pounds
LCC	Launch commit criteria
Ld_n	Day-night average noise level
LEO	Low Earth orbit
LEPC	Local Emergency Planning Committee
LF	Launch facility
LH_2	Liquid hydrogen
LMC	Lockheed Martin Corporation
LO_2	Liquid oxygen
LOC	Level of Concern
LOCC	Launch Operations Control Center
LOS	Level of service
LVC	Launch vehicle contractor
MAIS	Major Automated Information System
MDAC	McDonnell Douglas Astronautics Corp.
MDAPs	Major Defense Acquisition Programs
ME	Mission essential
MEK	Methyl ethyl ketone
mg	Milligram
MGD	Million gallons per day
mg/L	Milligrams per liter
mg/m^2	Milligrams per square meter

$\mu g/m^3$	Micrograms per cubic meter
MBPT	Migratory Bird Protection Treaty
MIS	Missile Inert Storage
MLV	Medium-lift vehicle
MLV+	Medium-lift variant with solid rocket motor strap-ons
mm	Millimeters
MMH	Monomethyl hydrazine
MOA	Memorandum of Agreement
MSDS	Material Safety Data Sheets
MST	Mobile Service Tower
N_2	Nitrogen
N_2H_4	Anhydrous hydrazine
N_2O_4	Nitrogen tetroxide
NA	Not applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NDE	Nondestructive evaluation
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NFRAP	No further response action planned
NH_3	Ammonia
NH_4ClO_4	Ammonium perchlorate
NIOSH	National Institute for Occupational Safety and Health
NME	Non-mission essential
NMFS	National Marine Fisheries Service
NMM	National Mission Model
NO_2	Nitrogen dioxide
NOI	Notice of Intent
NO_x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSP	National Space Policy
O_2	Oxygen (diatomic)
O_3	Ozone
OB/DG	Ocean Breeze/Dry Gulch
ODS	Ozone-Depleting Substances
OEHHA	Office of Environmental Health Hazard Assessment
OES	Office of Emergency Services
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OSPL	Overall sound pressure level
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PG-2	Triethyl boron/triethyl aluminum
pH	Hydrogen ion concentration

PM_{10}	Particulate matter equal to or less than 10 microns in diameter
POL	Petroleum, oil, and lubricants
PPF	Payload Processing Facility
ppm	Parts per million
PPMP	Pollution Prevention Management Plan
Pre-EMD	Pre-Engineering and Manufacturing Development
PSD	Prevention of Significant Deterioration
psf	Pounds per square foot
psi	Pounds per square inch
RCRA	Resource Conservation and Recovery Act
RCS	Reaction control system
REEDM	Rocket Exhaust Effluent Diffusion Model
REL	Recommended Exposure Limit
RFI	RCRA Facility Investigation
RI	Remedial investigation
RIS	Receipt Inspection Shop
RLCC	Remote Launch Control Center
ROD	Record of Decision
ROI	Region of influence
RP-1	Kerosene fuel (rocket propellant-1)
RSA	Range Standardization and Automation
SAP	Satellite accumulation points
SCCAB	South Central Coast Air Basin
SEIS	Supplemental Environmental Impact Statement
SEL	Sound exposure level
SHPO	State Historic Preservation Office
SI	Site Investigation
SIP	State Implementation Plan
SLC	Space Launch Complex
SLMP	Space Launch Modernization Plan
SMARF	Solid Motor Assembly and Readiness Facility
SO_2	Sulfur dioxide
SPCC	Spill Prevention Control and Contingency
SPD	System Performance Document
SPEGL	Short-term Public Emergency Guidance Level
SPF3	Standardized Plume Flowfield model
SPIF	Spacecraft Processing Integration Facility
SPP	JANNAF Solid Propellant to Rocket Motor Performance Computer Program
SR	State Route
SRM	Solid rocket motor
SRS	Segment Ready Storage
SSI	Space Systems International
SSPP	System Safety Program Plan
STEL	Short-term exposure limit
STS	Space Transportation System
SUS	Storable Upper Stage

SW	Space Wing
SWMU	Solid waste management unit
TCE	Trichloroethylene
TDK	Two-Dimensional Kinetics
THC	Toxic hazard control
TLV	Threshold Limit Value
TOMS	Total Ozone Mapping Spectrometer
TSDF	Treatment, storage, and disposal facility
TWA	Time-weighted average
UDMH	Unsymmetrical dimethylhydrazine
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAF/SG	U.S. Air Force/Surgeon General
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	Ultraviolet
UV-B	Ultraviolet light that is biologically damaging (sunlight)
VAFB	Vandenberg Air Force Base
VIB	Vehicle integration building
VIF	Vehicle Integration Facility
VOC	Volatile organic compounds
VPF	Vehicle processing facilities
WR	Western Range
WWTP	Wastewater treatment plant

Executive Summary

Background

In 1998, a *Final Environmental Impact Statement, Evolved Expendable Launch Vehicle Program* (1998 FEIS) was prepared to evaluate the impacts associated with the development and operation of the Evolved Expendable Launch Vehicle (EELV) systems. That action included replacing the Atlas IIA, Delta II, and Titan IVB launch vehicles in the National Executable Mission Model. The primary requirement of the EELV program is to provide the capability for lifting medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) satellites into a variety of different orbits. The EELV program is the Department of Defense's (DoD's) source of expendable medium and heavy spacelift transportation to orbit through the year 2020. The EELV program provides the capability to launch unmanned National Security, National Aeronautics and Space Administration (NASA), and commercial payloads into orbit. The Record of Decision (ROD) for the 1998 FEIS was signed on June 8, 1998.

Purpose and Need for Action

Subsequent to the publication of the 1998 FEIS, both EELV program launch vehicle contractors [Lockheed Martin Corporation (LMC) and Boeing] have proposed the use of solid-propellant strap-on rocket motors as an economical way to bridge the gap between their respective medium-lift vehicles (MLVs) and heavy-lift vehicles (HLVs). Boeing's use of solid rocket motors (SRMs) was previously evaluated in the 1998 FEIS. In this Final Supplemental Environmental Impact Statement (FSEIS), Boeing is now proposing to use larger SRMs than previously analyzed in the 1998 FEIS.

The Air Force is addressing the impacts of these proposals in this FSEIS because of the potential use of Air Force facilities and property for the new variants, as well as the potential that these variants could carry Air Force and other government payloads in the future. This FSEIS will support the Air Force's decision whether or not to: (1) allow additional and larger SRMs to be used at Vandenberg Air Force Base (AFB) and Cape Canaveral Air Force Station (CCAFS) for EELV program launches of commercial and/or government payloads, and (2) authorize use of government property for supporting the use of additional and larger SRMs for the EELV program. This FSEIS has been prepared in accordance with the National Environmental Policy Act (NEPA). This FSEIS addresses the potential environmental effects that could result from adding these new launch vehicle configurations to the EELV program.

In accordance with the NEPA requirement for a lead agency, the United States Air Force has prepared this FSEIS to provide information on the potential environmental impacts resulting from the additional use of SRMs on the Atlas V MLVs and larger SRMs on the Delta IV MLVs. Because commercial launches are included in the Proposed Action, the Federal Aviation Administration (FAA) is serving as a cooperating agency in the

preparation of this SEIS. In addition, NASA is also a cooperating agency because of their special expertise and potential mission requirements.

The Proposed Action and Alternatives

The Proposed Action of this SEIS is to allow use of launch vehicles with up to five strap-on SRMs. LMC proposes adding up to five strap-on SRMs to the current Atlas V MLV, while Boeing proposes a Delta IV MLV with two or four SRMs that are larger than those proposed in the 1998 FEIS. For LMC, these SRMs would be in addition to the previously analyzed Atlas V medium-lift vehicles. For Boeing, larger SRMs would be used than were previously analyzed in the 1998 FEIS on the Boeing Delta IV medium-lift vehicles. The Proposed Action would provide an intermediate-lift launch capability between the EELV medium- and heavy-lift variants that would increase the market capture of space launches by EELV vehicles, and could potentially address government mission requirements.

CCAFS in Brevard County, Florida, and Vandenberg AFB in Santa Barbara County, California, are the only two locations in the United States that currently provide space launch capabilities to support the EELV program. Both the Atlas V and Delta IV systems with added SRMs would be designed so that all configurations could be launched from both locations. The Delta IV launches would occur from Space Launch Complex-37 (SLC-37) at CCAFS and from SLC-6 at Vandenberg AFB; the Atlas V launches would occur from SLC-41 at CCAFS and from SLC-3W at Vandenberg AFB.

No-Action Alternative

The No-Action Alternative for this SEIS is the Proposed Action selected in the 1998 FEIS that has been updated to reflect current program status. The EELV program consists of MLVs and HLVs. The Atlas V system is based on a liquid oxygen and kerosene common core booster, while the Delta IV system is based on a liquid oxygen and liquid hydrogen common booster core. Under the No-Action Alternative, the EELV program would continue, except that SRMs would not be added to the Atlas V MLVs and smaller SRMs would be used on Delta IV MLVs. The No-Action Alternative will occur whether or not the Proposed Action is implemented.

Some changes to the EELV program baseline systems have occurred independent of the Proposed Action for this SEIS since the ROD for the 1998 FEIS was signed. The following updates to the EELV program that occurred in the interim between the ROD for the 1998 FEIS and the Notice of Intent (NOI) for this SEIS are incorporated into the No-Action Alternative:

- Increased water usage for Atlas V launches (see Section 3.5, 4.9, and 4.9.2)
- The launch rates have decreased for the No-Action Alternative in this SEIS from the rates assessed in the Proposed Action of the 1998 FEIS (see Section 2.1.3)
- Minor modifications to existing facilities and increased paved area for vehicle turnaround at the Receipt Inspection Shop and Segment Ready Storage at CCAFS (see Section 2.1.3)

- Deletion of certain launch vehicle configurations; for example, the Delta IV small-lift vehicle analyzed in the 1998 FEIS has been removed from the EELV program, and is not included as part of the No-Action Alternative for this SEIS (see Section 2.2.1.2)

With the inclusion of these updated items, the Proposed Action of the 1998 FEIS is incorporated by reference into the description of the No-Action Alternative for this SEIS.

Scope of Study

Analyses of potential impacts to the following areas are evaluated: geology and soils, water resources, air quality, noise, orbital debris, biological resources, cultural resources, population and employment, land use and aesthetics, transportation, utility services, and the current and future management of hazardous materials and health and safety issues. Potential environmental justice impacts to minority and/or low-income populations that could occur as a result of the Proposed Action are also addressed. This SEIS does not preclude or supersede any previously selected action or launch vehicle configuration (with the exception of the Delta IV small-lift vehicle) from the 1998 FEIS.

Summary of Environmental Impacts

The SEIS has analyzed potential impacts to the environment from the Proposed Action and No-Action Alternative in accordance with NEPA. On the basis of the analyses contained in this document, no significant environmental impacts are expected to occur with implementation of either the Proposed Action or the No-Action Alternative, and neither is anticipated to contribute to any cumulative impacts or result in irreversible or irretrievable commitments of resources. The following paragraphs briefly describe environmental areas analyzed for the Proposed Action and the No-Action Alternative. The number in parentheses next to each resource area indicates the location in the SEIS where a more detailed discussion of potential impacts is included. Table ES-1 (included at the end of this Executive Summary) contains a summary of the impacts and mitigation for the Proposed Action and No-Action Alternative.

Community Setting (Section 4.2)

Proposed Action

The Proposed Action would not result in impacts to the local or regional economy, or result in growth-inducing impacts. The employment trends would be the same as those of the No-Action Alternative.

No-Action Alternative

The total number of persons associated with launch activities at both CCAFS and Vandenberg AFB will increase during construction of the EELV program facilities, then will decline until 2007, as other existing government launch programs are phased out. There will be an overall net decline in direct and indirect launch-related employment. This decrease, however, is expected to be small compared to the increases in jobs forecast in both locations.

Land Use and Aesthetics (Section 4.3)

Proposed Action

Land use would be the same as for the No-Action Alternative. The Proposed Action would not be anticipated to result in impacts to regional or local land uses, the coastal zone, recreation, or aesthetics, either separately or in combination.

No-Action Alternative

The No-Action Alternative will be compatible with current land use at both Vandenberg AFB and CCAFS. The EELV program construction and facility modifications were assessed in the 1998 FEIS, and a Coastal Zone Consistency Determination has been prepared for the existing EELV program activities at both installations.

Transportation (Section 4.4)

Proposed Action

The same transportation trends would occur as under the No-Action Alternative. Regional traffic would not be expected to be affected by the addition of SRMs to Atlas V vehicles or the use of larger of SRMs on Delta IV vehicles at either installation.

No-Action Alternative

Under the No-Action Alternative, traffic will increase slightly during construction activities resulting in changes to level-of-service (LOS) for both installations. These changes will be temporary in nature and will not result in significant impacts to local or regional traffic patterns. During the operational phase of the EELV program, project-related traffic is expected to decline, and no impacts to regional traffic patterns are anticipated. The number of truck trips offsite have been revised to reflect corrected quantities of wastewater to be removed from SLC-3W at Vandenberg AFB.

Utilities (Section 4.5)

Proposed Action

Water use, wastewater treatment, solid waste generation, and electrical distribution systems required for the Proposed Action would be no different from the No-Action Alternative requirements.

No-Action Alternative

Under the No-Action Alternative, all utility systems will operate within the capacity of Vandenberg AFB and CCAFS. As a result, no significant impacts will occur.

Hazardous Materials and Hazardous Waste Management (Section 4.6)

Proposed Action

Under the Proposed Action, total hazardous materials and hazardous waste would increase slightly over the No-Action Alternative. These increases would result from the use of additional and larger SRMs and an increase in the total number of launches over the

No-Action Alternative. Generated materials and wastes would be consistent with materials and wastes currently handled at both installations and are the responsibilities of the launch vehicle contractors. All launch activities would be conducted in accordance with applicable regulations for the use, storage, and disposition of hazardous materials. The Proposed Action would stage and temporarily store SRMs onsite or at approved locations nearby. Because wastes from the Proposed Action would be similar to wastes currently handled at the installations, no adverse impacts are anticipated.

No-Action Alternative

Under the No-Action Alternative, there will be no change in the amount of hazardous wastes generated from the analysis conducted for the 1998 FEIS. All launch activities will be conducted in accordance with applicable regulations for the use and storage of hazardous materials. The types of wastes will be consistent with wastes currently handled by both installations. The launch contractors are responsible for storing and disposing of hazardous materials and wastes. No significant impacts are anticipated.

Health and Safety (Section 4.7)

Proposed Action

As a result of implementing safety programs at the installations prior to launch activities, no significant impacts to health and safety would be expected to occur as a result of the Proposed Action. In addition, all hazardous materials would be transported in accordance with U.S. Department of Transportation (DOT) regulations for interstate shipment of hazardous substances.

Launch trajectories would be created and modified to ensure safety on the ground and at sea. These scenarios represent no change from the No-Action Alternative except for the addition of SRM drop zones.

No impacts would be expected as a result of airborne chemicals emitted from the SRMs. A hydrogen chloride (HCl) ground cloud would be larger and would occur more frequently given the increased use of SRMs and increased launch rates compared to the No-Action Alternative. As in the No-Action Alternative, established safety procedures at CCAFS and Vandenberg AFB would prevent or minimize exposure to toxic launch emissions.

No-Action Alternative

The current regional and on-station safety programs described in the 1998 FEIS will remain in effect.

An HCl ground cloud will result from launches of one MLV configuration. Established procedures at CCAFS and Vandenberg AFB will prevent or minimize exposure to toxic launch emissions.

Geology and Soils (Section 4.8)

Proposed Action

There would be additional paving for vehicle turnaround at the Receipt Inspection Shop and at the Segment Ready Storage at CCAFS to transport the SRMs for the Delta IV vehicles. At both CCAFS and Vandenberg AFB, there would be no or less-than-significant impacts to geology and soils.

No-Action Alternative

Construction activities will uncover and disturb soils, increasing the potential for wind and water erosion. As described in the 1998 FEIS, appropriate measures to control soil erosion will be implemented, and no adverse impacts are expected to occur.

Water Resources (Section 4.9)

Proposed Action

Significant adverse impacts to surface water and groundwater are not anticipated. Implementation of the Proposed Action would not affect the quantity of water available to the installations or to the surrounding areas, nor would it increase the amount of water withdrawn from groundwater resources. Therefore, adverse impacts to groundwater resources are not expected, and no mitigation measures would be required.

There would be no changes in the National Pollution Discharge Elimination System (NPDES) requirements for stormwater discharges associated with construction activity. Launch pad deluge and washdown water would be recycled after launches, or discharged and/or disposed of in accordance with applicable industrial wastewater permits and regulations.

The use of additional SRMs would result in increased deposition of HCl into surface waters at both launch installations. Any resulting pH changes would be temporary.

No-Action Alternative

Previously selected EELV program activities will not affect the quantity of water available to the installations or to the surrounding areas, nor will they increase the amount of water withdrawn from groundwater resources.

For Atlas V and Delta IV system launches at CCAFS and at Vandenberg AFB, there will be an increase in deluge and/or launch-pad-washdown water used. In the interim since publication of the 1998 FEIS, total water use per launch has been revised. More definitive design data now indicate a need for additional water, and the increased water use was evaluated. On the basis of the revised water requirements, the quantity of water required by CCAFS on a daily basis from the local municipal water department (City of Cocoa Water Department) is anticipated to change from the quantity forecast in the 1998 FEIS.

Water is delivered to Vandenberg AFB from the central branch of the State Water Project. This increased water use is not expected to exceed the current contractual supply of water available from the State Water Project. Consequently, no impacts to the quantity and availability of local water resources are expected to occur.

No adverse impacts to water resources are expected. Acid deposition could cause short-term changes in water chemistry after launches of SRM–augmented launch vehicle configurations, but any impacts will be temporary and are not expected to be significant.

Air Quality (Lower Atmosphere) (Section 4.10)

Proposed Action

Construction for the Proposed Action would be essentially the same as for the No-Action Alternative. The increased use of SRMs and increased frequency of launches would increase emissions of some criteria pollutants. Neither peak launch nor construction year emissions, however, would be sufficient to jeopardize attainment status of either region. Because Vandenberg AFB is within an area designated by the U.S. Environmental Protection Agency (EPA) to be in nonattainment for ozone, EELV program activities must comply with Clean Air Act (CAA) requirements mandating that federal actions comply with the applicable State Implementation Plan (SIP) to achieve attainment.

Monitoring stations at Vandenberg AFB have not recorded any exceedances of the California State 24-hour PM_{10} standard from current launch systems (including the much larger Titan IV launch vehicle).

No-Action Alternative

Construction-related activities will generate an increase in local concentrations of particulates, NO_x and other pollutants. These emissions, however, will not jeopardize the attainment status for these pollutants. Applying water during ground-disturbing activities and the efficient scheduling of heavy equipment use will mitigate particulates generated by construction. Launch-vehicle preparation and assembly activities will generate short-term air emissions. Because of the increased number of trucks used to transport wastewater offsite at SLC-3W, the quantities of vehicle emissions were corrected from the 1998 FEIS. Computations indicate that launch operations will not jeopardize the attainment status for the above-referenced pollutants.

Air Quality (Upper Atmosphere) (Section 4.11)

Proposed Action

The increased use of SRMs would generate increased emissions of aluminum oxide, nitrogen oxides, and chlorine compounds into the stratosphere that would affect stratospheric ozone. Temporary local ozone losses would occur more frequently and over larger areas than under the No-Action Alternative. Cumulative global impacts to stratospheric ozone over the lifetime of the EELV program would depend on the future rate of EELV program commercial launches with SRMs. A conservative estimate of the yearly EELV contribution to the total annual global ozone decrease, based on the maximum expected launches of vehicles with SRMs, is less than 0.1 percent of existing conditions. This constitutes an insignificant decrease in global ozone.

No-Action Alternative

Emissions of aluminum oxide, nitrogen oxides, and chlorine compounds into the stratosphere will occur with the launch of only one Delta IV variant. Temporary local ozone

losses will occur with each launch using SRMs. Cumulative global impacts to stratospheric ozone over the lifetime of the EELV program will depend on the future rate of EELV program commercial launches with SRMs. A conservative estimate of the yearly EELV contribution to the total annual global ozone decrease, based on the maximum expected launches of vehicles with SRMs, is less than 0.1 percent of existing conditions. This constitutes an insignificant decrease in global ozone.

Noise (Section 4.12)

Proposed Action

Launch noise would be short term and intermittent, occurring only during launches. No public or structural impacts would be expected. Sonic boom footprints for launches from CCAFS are offshore over the Atlantic Ocean. At Vandenberg AFB, sonic booms could occur over the Channel Islands, as they do now with other launch programs, and as they could with the No-Action Alternative.

No-Action Alternative

Under the No-Action Alternative, only short-term and temporary impacts from noise or sonic booms are expected to occur, as described for the Proposed Action.

Orbital Debris (Section 4.13)

Proposed Action

The Proposed Action would increase the total EELV program launches to 566, from 472 in the revised No-Action Alternative. Given the increased launch rate, there would be a nominal increase in orbital debris from domestic vehicles; however, overall there would be no significant global effect on orbital debris.

No-Action Alternative

There will be a nominal increase in orbital debris attributable to EELV program. This increase will be offset by losses in other launch vehicle programs in a zero-sum equation; therefore, the total number of worldwide launches would remain essentially unchanged. Furthermore, the launch vehicle contractors are required to incorporate debris minimization into system design for upper stages, as described in the 1998 FEIS.

Biological Resources (Section 4.14)

Proposed Action

Minor temporary disturbances would be expected during the small-scale construction activities associated with the Proposed Action. Minor modifications to existing facilities would not affect any critical habitat or jurisdictional wetlands.

There would be larger and more frequent HCl ground clouds from the increased use of SRMs, temporarily affecting flora and fauna at both installations. The effects of HCl and aluminum oxide (Al_2O_3) deposition from SRMs at both installations would be minimal. Plant species are expected to recover from short-term launch impacts. Damaged vegetation

resulting from a launch anomaly would be expected to regrow within the same growing season, because no lingering effects would be present.

Increases in launch rates from the levels assessed in the No-Action Alternative would cause increased frequency of launch noise and associated temporary disturbances of local species. Based on the infrequent and brief occurrence of launch noise resulting from the Proposed Action, however, no significant increases to impacts from the No-Action Alternative would be expected to occur to wildlife. Noise levels associated with the Proposed Action have been predicted to be 2 to 3 dB lower than the noise associated with the HLV previously analyzed in the 1998 FEIS. Sonic booms over the Channel Islands could have the potential to result in temporary disturbances of marine mammals.

No-Action Alternative

Under the No-Action Alternative, there would be minimal effects to biological resources from the deposition of HCl and Al_2O_3 associated with the continued use of SRMs. Other direct effects to vegetation and wildlife will be a result of EELV program construction activities at both installations that were analyzed in the 1998 FEIS. Launch noise and sonic boom disturbances to wildlife would be short term and infrequent.

Cultural Resources (Section 4.15)

Proposed Action

There would be no effects to any National Register of Historic Places (National Register)-listed or -eligible prehistoric or historic archaeological sites, or archaeologically sensitive areas. No traditional resources have been identified in the Area of Potential Effect (APE) at either installation. Impacts would be the same as for the No-Action Alternative.

No-Action Alternative

Construction activities associated with implementation of the EELV program were analyzed in the 1998 FEIS. No National Register-listed or -eligible prehistoric or historic archaeological sites, or archaeologically sensitive areas will be affected at either installation. At CCAFS, concurrence has been obtained from the Florida State Historic Preservation Office (SHPO) that the construction at Hangars C and J (both potentially eligible for listing on the National Register of Historic Places) will have no effect on their historic value.

At Vandenberg AFB, SLC-3W and its associated support facilities are eligible for listing on the National Register of Historic Places under the Cold War historic context. The California SHPO and the Air Force signed a Memorandum of Agreement (MOA) stipulating that adverse effects to the property have been satisfactorily taken into account through the previous completion of Historic American Building Survey/Historic American Engineering Record(HABS/HAER) recordation for SLC-3. The California SHPO also concurred that the potential impacts to a National Register-eligible archaeological site near SLC-6 will be minimal and will not affect any of the characteristics that make it eligible for inclusion in the National Register.

Environmental Justice (Section 4.16)

Activities associated with the Proposed Action and the No-Action Alternative will not result in disproportionately high and adverse impacts to low-income or minority populations as described in the 1998 FEIS.

TABLE ES-1
Potential Environmental Impacts at CCAFS and Vandenberg AFB

Receptor	Location	Proposed Action	No-Action Alternative
Local Community	**CCAFS**	Same employment trends as No-Action Alternative.	Employment impacts are described in the 1998 FEIS.
	VAFB	Same employment trends as No-Action Alternative.	Employment impacts are described in the 1998 FEIS.
Land Use and Aesthetics	**CCAFS**	Same land use and coastal zone impacts as No-Action Alternative.	Land use and coastal zone consistency impacts are described in the 1998 FEIS.
	VAFB	Same land use and coastal zone impacts as No-Action Alternative. Coordination required with California Coastal Commission for Coastal Zone Consistency Determination.	Land use and coast zone consistency are described in the 1998 FEIS.
Transportation	**CCAFS**	Same impacts as No-Action Alternative plus occasional minimal increase in traffic for truck trips to transport SRMs.	Temporary traffic from construction is described in the 1998 FEIS, with no impact to regional traffic.
	VAFB	Same trends as No-Action Alternative plus occasional increase in truck trips to transport SRMs and remove launch-pad washdown water.	Traffic impacts from construction are described in the 1998 FEIS with no impact to regional traffic. The number of truck trips offsite have been revised to reflect corrected quantities of wastewater to be removed from SLC-3W at VAFB.
Utilities	**CCAFS**	Same as No-Action Alternative.	Consumption data are provided in the 1998 FEIS. All systems will operate within CCAFS capacity.
	VAFB	Same as No-Action Alternative.	Consumption data are provided in the 1998 FEIS. All systems will operate within VAFB capacity.
Hazardous Materials and Hazardous Waste Management	**CCAFS**	Hazardous waste impacts over the No-Action Alternative would result from increased use of SRMs and increased launch rates. Launch vehicle contractors would be responsible for pollution prevention and storage and disposal of hazardous wastes. Because generated materials and wastes would be consistent with those currently managed in accordance with applicable regulations, no significant impacts are expected.	Launch vehicle contractors are responsible for pollution prevention and for storage and disposal of hazardous wastes. Quantities are provided in the 1998 FEIS.
	VAFB	Hazardous waste impacts over No-Action Alternative would result from increased use of SRMs and increased launch rates. Launch vehicle contractors would be responsible for pollution prevention and storage, management, and disposal of hazardous materials wastes. Because generated materials and wastes would be consistent with those currently managed in accordance with applicable regulations, no significant impacts are expected.	Launch vehicle contractors are responsible for pollution prevention, and for storage management and disposal of hazardous materials and wastes. Quantities are provided in the 1998 FEIS.

TABLE ES-1
Potential Environmental Impacts at CCAFS and Vandenberg AFB

Receptor	Location	Proposed Action	No-Action Alternative
Health and Safety	**CCAFS**	Same procedures for avoidance and mitigations as No-Action Alternative. HCl ground cloud would be larger and occur more frequently because of increased use of SRMs and increased launch rates. Implementation of established safety procedures would result in insignificant impacts.	HCl ground cloud will occur with one type of MLV, but established procedures will ensure no exposure to the general public, as described in the 1998 FEIS.
	VAFB	Same procedures for avoidance and mitigations as No-Action Alternative. HCl ground cloud would be larger and occur more frequently because of increased use of SRMs and increased launch rates. Implementation of established safety procedures would result in insignificant impacts.	HCl ground cloud will occur with one type of MLV, but established procedures will ensure no exposure to the general public, as described in the 1998 FEIS.
Geology and Soils	**CCAFS**	Same as No-Action Alternative, plus minor ground disturbance for paving activity for vehicle turnaround at the Receipt Inspection Shop and the Segment Ready Storage facilities. The area to be paved has previously been disturbed, and the potential for erosion would be negligible.	Construction activities will disturb soil, increasing the potential for erosion. Appropriate erosion control measures will be implemented and no adverse impacts are expected, as described in the 1998 FEIS.
	VAFB	Same as No-Action Alternative with no additional ground-disturbing activities beyond the No-Action Alternative.	Construction activities will disturb soil, increasing the potential for erosion. Appropriate erosion control measures will be implemented and no adverse impacts are expected, as described in the 1998 FEIS.
Water Resources	**CCAFS**	Same water usage as No-Action Alternative. Increased amounts of HCl deposition compared to No-Action Alternative, with no long-term surface water impacts.	Water required for EELV launch activities will not affect the amount of water available to CCAFS or the region. EELV water usage was underestimated in the 1998 FEIS, but corrected for this SEIS. No long-term effects on surface waters are expected as a result of HCl deposition.
	VAFB	Same water usage as No-Action Alternative. Increased amounts of HCl deposition compared to No-Action Alternative, with no long-term surface water impacts.	The amount of water required for EELV launch activities will not affect the amount of water available to VAFB or the region. EELV water usage was underestimated in the 1998 FEIS, but corrected for this SEIS. No long-term effects on surface waters are expected as a result of HCl deposition.

TABLE ES-1
Potential Environmental Impacts at CCAFS and Vandenberg AFB

Receptor	Location	Proposed Action	No-Action Alternative
Air Quality (Lower Atmosphere)	**CCAFS**	Construction and operational emissions would be the same as for the No-Action Alternative. Increased use of SRMs and increased frequency of launches would increase particulates, NO_x and other pollutants. All predicted concentrations are less than the corresponding standards. Impacts would be less than significant.	Quantities of construction vehicle emissions were corrected from the 1998 FEIS. Mobile source emissions will increase during construction, but will not exceed regulatory standards during any program years.
	VAFB	Construction emissions would be the same as for the No-Action Alternative. Increased use of SRMs and increased frequency of launches would increase particulates, NO_x and other pollutants. All predicted concentrations are less than the corresponding standards. Impacts would be less than significant.	Quantities of construction vehicle emissions were corrected from the 1998 FEIS to account for additional truck trips to remove launch deluge wastewater. Mobile source emissions will increase during construction, but will not exceed regulatory standards during any program years.
Air Quality (Upper Atmosphere)	**CCAFS**	Increased use of larger SRMs would result in increased chlorine and particulate emissions over the No-Action Alternative. An insignificant increase in ozone losses would occur locally and globally compared to the No-Action Alternative.	Quantities of vehicle emissions for No-Action Alternative were corrected from the 1998 FEIS. Small SRMs on one MLV will emit chlorine substances and particulates, resulting in temporary local ozone loss and small global contributions.
	VAFB	Increased use of larger SRMs would result in increased chlorine and particulate emissions over the No-Action Alternative. An insignificant increase in ozone losses will occur locally and globally compared to the No-Action Alternative.	Quantities of vehicle emissions for No-Action Alternative were corrected from the 1998 FEIS. Small SRMs on one MLV will emit chlorine substances and particulates, resulting in temporary local ozone loss and small global contributions.
Noise and Sonic Booms	**CCAFS**	Magnitude and location of launch noise and sonic booms would be similar to the No-Action Alternative. Frequency of noise and sonic booms would increase over the No-Action Alternative given the increased launch rate, but would be temporary.	Launch noise will be short term and temporary. Sonic boom footprints will occur over the Atlantic Ocean, as described in the 1998 FEIS.
	VAFB	Magnitude and location of launch noise and sonic booms would be similar to the No-Action Alternative. Frequency of noise and sonic booms would increase over the No-Action Alternative given the increased launch rate, but would be temporary and infrequent.	Launch noise would be short term and temporary. Sonic boom footprints were over the Channel Islands and the Pacific Ocean, as described in the 1998 FEIS.
Orbital Debris	**CCAFS**	Due to the increased launch rate compared to the No-action Alternative, there would be a nominal increase in orbital debris from domestic vehicles, but overall there will be no significant global effect on orbital debris.	Increased commercial launch rates for all launch vehicles will increase orbital debris over EELV's lifetime. Launch vehicle contractors are required to incorporate debris minimization into system design for upper stages, as described in the 1998 FEIS.
	VAFB	Due to the slight increase in launch rate compared to the No-Action Alternative, there would be a nominal increase in orbital debris from domestic vehicles, but overall there will be no significant global effect on orbital debris.	Increased commercial launch rates for all launch vehicles will increase orbital debris over EELV lifetime. Launch vehicle contractors are required to incorporate debris minimization into system design for upper stages, as described in the 1998 FEIS.

TABLE ES-1
Potential Environmental Impacts at CCAFS and Vandenberg AFB

Receptor	Location	Proposed Action	No-Action Alternative
Biological Resources	**CCAFS**	Increased launch rates over the No-Action Alternative would cause increased frequency of launch noise and associated temporary startle effects to local species. Larger and more frequent HCl ground clouds would occur from increased use of SRMs, temporarily affecting pad vegetation, birds, and small mammals in the vicinity.	Some construction activities could result in minor and transitory impacts to biological resources, as described in the 1998 FEIS.
	VAFB	Increased launch rates over the No-Action Alternative would cause increased frequency of launch noise and associated temporary startle effects to local species. Increased frequency of sonic booms over the Channel Islands would cause more frequent temporary disturbance of pinnipeds. Larger and more frequent HCl ground clouds would occur from increased use of SRMs, temporarily affecting pad vegetation, birds, and small mammals in the vicinity.	Some construction activities may result in minor and transitory impacts to biological resources, as described in the 1998 FEIS. EELV operations will cause intermittent and temporary noise and sonic booms and associated temporary startle effects to local species. Occasional launches of one vehicle configuration will result in temporary effects on flora and fauna.
Cultural Resources	**CCAFS**	Same as No-Action Alternative.	Cultural and historic surveys pertaining to EELV construction and activities are described in the 1998 FEIS. No cultural or historic sites will be affected.
	VAFB	Same as No-Action Alternative.	Cultural and historic surveys pertaining to EELV construction and activities are described in the 1998 FEIS. No cultural or historic sites will be affected. Construction activities at SLC-6 will require archaeological and Native American monitoring.
Environmental Justice	**CCAFS**	Same as No-Action Alternative.	Activities will not cause disproportionately high or adverse impacts to low-income or minority populations, as described in the 1998 FEIS.
	VAFB	Same as No-Action Alternative.	Activities will not cause disproportionately high or adverse impacts to low-income or minority populations, as described in the 1998 FEIS.

CCAFS = Cape Canaveral Air Force Station.
VAFB = Vandenberg Air Force Base.

1.0 Purpose and Need for Action

In 1998, the U.S. Air Force issued a *Final Environmental Impact Statement, Evolved Expendable Launch Vehicle Program* (1998 FEIS) that assessed the potential environmental impacts resulting from the development, deployment, and operation of the Evolved Expendable Launch Vehicle (EELV) program. In that document, two baseline vehicle configurations were evaluated, Concept A and Concept B. The EELV program evaluated under the 1998 FEIS included small-, medium-, and heavy-lift variants designed to deliver payloads of varying sizes and masses to Earth orbit. In "Concept A," now called the Atlas V system, Lockheed Martin Corporation (LMC) proposed vehicles that have a liquid-oxygen/kerosene core booster. In "Concept B," now referred to as the Delta IV system, McDonnell-Douglas Corporation, a wholly owned subsidiary of The Boeing Company (Boeing) proposed vehicles that have a liquid-oxygen/liquid-hydrogen booster core. The 1998 FEIS "Concept B" analysis also considered the use of small, strap-on, solid rocket motors (SRMs) on some commercial launches of the medium-lift Delta IV system. Implementation of both Concept A and Concept B vehicles (Concept A/B) was also evaluated in the 1998 FEIS. Following issuance of the Record of Decision (ROD) for the 1998 FEIS in June 1998, the Air Force awarded development agreements and initial launch services contracts to LMC and Boeing. In addition, the Air Force entered into real property agreements with both contractors, permitting the use of Air Force facilities for the deployment of EELVs. As a result of these actions, future launch forecasts outlined in this document reflect both the Atlas V system with SRMs and the Delta IV system with larger SRMs for expected commercial and potential government missions.

1.1 Purpose and Need

Both LMC and Boeing have proposed the use of medium-lift vehicle (MLV) configurations in the EELV using SRMs to help them meet changing launch service demands. LMC's proposed use of SRMs was not considered in the 1998 FEIS, and Boeing has now proposed larger SRMs than were analyzed in the original 1998 FEIS. As a result, both of these new proposals are being considered in this *Final Supplemental Environmental Impact Statement, Evolved Expendable Launch Vehicle Program* (FSEIS). The rationale for both launch vehicle contractors (LVCs) to develop these SRM-augmented vehicles stems from two trends in spacecraft size. Commercial payloads are growing in size beyond the capabilities of MLVs, while the government, through miniaturization advances and simpler spacecraft design, is requiring fewer heavy-lift launches, such as the Titan IV. The Commercial Space Transportation Advisory Committee (COMSTAC) attributes this trend to an increased demand for commercial communications capability in orbit. This demand is being satisfied with larger, more powerful communication satellites, or with the deployment of multiple, smaller satellites from the same launch vehicle. LMC and Boeing have proposed using SRMs to allow them to serve larger payloads with SRM-augmented MLVs, rather than putting the payloads on more costly, heavy-lift vehicles (HLVs).

LMC has proposed an Atlas V vehicle that uses up to five SRMs to augment the liquid-oxygen/kerosene core booster on its medium-lift variant. Boeing has proposed the use of either two or four larger SRMs on their MLV—larger than those originally proposed in the 1998 FEIS. Incorporating SRMs would allow both EELV programs to offer intermediate-lift vehicles with the performance needed to bridge the lift-capability gap between existing medium- and heavy-lift variants.

Implementation of these upgraded launch vehicles is consistent with the U.S. Government's desire to encourage the United States commercial launch industry [42 U.S.C. 26 Sec 2465b and P.L. 103 - 272, Sec. 1 (e), July 1994, 108 Stat. 1330, the Commercial Space Launch Act as codified in 49 U.S.C. Sec 70101, January 26, 1998, and National Space Policy (NSP) Directive No. 1, November 2, 1998]. In doing so, the Air Force is evaluating in this FSEIS the most current status of the systems proposed by the launch vehicle contractors. This current status does not include certain facilities and launch vehicle configurations that were analyzed in the 1998 FEIS, but are now no longer proposed by the launch vehicle contractors. These facilities and vehicle configurations were previously analyzed in the 1998 FEIS and allowed for implementation by the Record of Decision (ROD). Use of the previously analyzed configurations in combination with activities specifically analyzed in this FSEIS (e.g., a previously analyzed upper stage employing hypergolic fuels mated to a newly analyzed SRM-augmented launch vehicle), however, would be subject to additional environmental analysis, as necessary.

The Air Force is addressing the impacts of these proposals in this FSEIS because of the potential use of Air Force facilities and property for the new variants, as well as the potential that these variants may carry Air Force and other government payloads in the future.

1.2 Decisions to be Made

This FSEIS will support the Air Force decision whether or not to:

- Allow additional and larger SRMs to be used at Vandenberg Air Force Base (AFB) and Cape Canaveral Air Force Station (CCAFS) for EELV program launches of commercial and/or government payloads
- Authorize use of government property for supporting the use of additional and larger SRMs for the EELV program

1.3 Scope

This document has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969; the President's Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA; Air Force Instruction (AFI) 32-7061, The Environmental Impact Analysis Process; Department of Defense (DoD) Regulation 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs, (Includes Change 3), March 23, 1998.

1.3.1 Public Participation Process

The public participation process provides an opportunity for public involvement in the development of an EIS. In the case of an FSEIS, useful public information may also be derived from the original scoping process. The public scoping process for the 1998 FEIS began when the Notice of Intent (NOI) to prepare an EIS for the development and deployment of the EELV program was published in the *Federal Register* on February 19, 1997. Notification of public scoping for the original EELV program EIS was also made through the local media, as well as through letters to federal, state, and local agencies and officials; and interested groups and individuals. The Air Force held two public meetings during the original EELV program public scoping period to solicit comments and concerns from the general public: one in Cape Canaveral, Florida, on March 11, 1997 and one in Lompoc, California, on March 13, 1997. In addition to oral comments received at these meetings, written comments were also received during the scoping process. The public comment period for the original Draft EIS was 45 days (between December 1997 and February 1998), and included public hearings in Cape Canaveral, Florida on January 13, 1998 and Lompoc, California, on January 15, 1998.

The NOI to prepare the Draft SEIS assessing the use of additional and larger SRMs for the EELV program was published in the *Federal Register* on April 12, 1999. The public scoping period for the EELV program Draft Supplemental Environmental Impact Statement (DSEIS) began on April 13, 1999, and ended May 31, 1999. The Air Force used comments received during the original scoping process and public comment period, as well as NEPA requirements and information from previous Air Force programs, to determine the scope and direction of studies/analyses necessary for this FSEIS. Appendix M lists the recipients of the Notice of Availability of the DSEIS. Additional information on the public hearing process for the DSEIS is in Section 9, including copies of all the comments received and responses to those comments.

1.3.2 Scope of the FSEIS

The Council on Environmental Quality Regulations implementing NEPA, specifically 40 CFR 1502.9(c), states: "...an agency shall prepare supplements to either draft or final environmental impact statements when substantial changes in the proposed action are made relevant to environmental concerns." The Proposed Action (to permit the use of EELV program vehicles with additional or larger strap-on SRMs) might be considered a substantial change to the action previously analyzed in the 1998 FEIS. Under the Proposed Action, LMC would add SRMs to the Atlas V system MLV configuration, while Boeing would increase the number and size of SRMs used on the Delta IV MLV. Both LVC's rationale for using SRMs is to capture a larger share of the global launch market. As a result, changes in commercial launch forecasts through 2020 are being considered in this FSEIS, along with potential changes in government launch forecasts.

The Air Force has prepared this supplemental document to analyze the potential environmental impacts associated with the use of additional and/or larger SRMs on EELV program MLVs. The scope of this FSEIS is limited to activities directly associated with the use of SRMs in the EELV program (e.g., facilities modifications, launch base processing, and launches). The environmental effects of satellites using SRM-augmented vehicles are not

addressed in this document. Additional NEPA analysis would be conducted for each of the satellite programs, as required.

Because SRMs are intended to be used for both government and commercial payloads, this FSEIS describes both types of launches. Future launch operations are estimated in this document for purposes of analysis; these operations, however, may be increased, reduced, or modified, depending on actual commercial markets and depending on government requirements (should the government elect to use these vehicles). If actual launch rates exceed those projected in this FSEIS, additional NEPA analyses may be required.

The potential impacts associated with use of the launch vehicles and facilities proposed in this FSEIS have been assessed using the most current information available. Additional environmental documentation will be prepared, as necessary, if any changes occur to the vehicles, facilities, or SRM-related activities outlined in this document.

Operational processing facilities at CCAFS and Vandenberg AFB not related to the use of SRMs, but still discussed in this FSEIS, would be used for other aspects of the EELV program.

1.3.3 Cooperating Agencies

Licensing of commercial launch operations is considered a major federal action and is subject to NEPA requirements. The Federal Aviation Administration, Office of the Associate Administrator for Commercial Space Transportation (FAA/AST), assesses the potential environmental impacts of a license applicant's proposed actions. Because of the commercial EELV program activities, the FAA is serving as a cooperating agency in the preparation of this FSEIS. The FAA may also use the FSEIS to fulfill its NEPA requirements associated with commercial licensing requirements for the EELV program.

The National Aeronautics and Space Administration (NASA) is also serving as a cooperating agency for this EELV program FSEIS. Several potential NASA payloads are included in the mission planning for the EELV program.

1.4 Relevant Federal Permits, Licenses, and Entitlements

The representative federal permits, licenses, and entitlements that could be required of the EELV program are presented in Appendix N. More detailed discussions of environmental regulations are provided in the 1998 FEIS, and Sections 3.0 and 4.0 of this FSEIS.

2.0 Alternatives Including the Proposed Action

2.1 Description of the Proposed Action

2.1.1 Background

Space launch in the United States began in 1958 with the conversion of early intermediate-range missiles, and inter-continental ballistic missiles (ICBM) to orbital payload delivery systems. In the 1960s and 1970s, the United States began work to establish an economical space launch capability based on entirely new, or "clean sheet" programs. While several options were considered, the result was the Space Transportation System (STS) or "Space Shuttle" currently flown by NASA. By the 1980s, the United States had positioned itself to rely almost exclusively on the Shuttle for our nation's space launch needs. The resulting stand-down of the STS following the *Challenger* disaster in 1986, however, left the United States with almost no space launch capability. This event served as a stark reminder that space launch is still a complex and frequently risky endeavor. Because of the nation's reliance on space-based systems to meet critical national security needs, production of more ICBM-based launch vehicles was reinitiated in 1987 to fill the void created by limitations inherent in exclusive reliance on the STS. As a result, several space launch vehicles were used to mitigate the risks of any single system failure. Originally implemented as a "stop-gap" measure pending the development of new space launch systems, the family of launch vehicles, along with STS, still comprises the majority of our nation's space launch capability today.

In 1994, Congress passed legislation that was the impetus for a major study to be accomplished by the DoD. This study became the basis for a clearly defined national course of action undertaken to reduce significantly the cost of space launches. The Fiscal Year 1994, National Authorization Act, P.L. 103-160, Section 213 (a), in part, read:

> "The Secretary of Defense shall develop a plan that establishes and clearly defines priorities, goals, and milestones regarding modernization of space launch capabilities for the Department of Defense or, if appropriate, for the government as a whole."

In response to the law, the Air Force was tasked to produce the plan. The study included participation from each of the nation's four space sectors: defense, intelligence, civil, and commercial. The Space Launch Modernization Plan (SLMP) was developed between January and May of 1994. Information was collected from government agencies, industry, laboratories, and "think tanks." Inputs were also obtained from interviews with members of Congress and Congressional staff, industry executives, and current and past space leaders.

The SLMP identified four alternative courses of action: (1) continue with current space launch systems, (2) evolve current expendable launch systems, (3) develop a clean-sheet expendable launch system, and (4) develop a new reusable system.

Following the submission of the 1996 President's Budget, and approval of the Office of the Secretary of Defense (OSD) and the Administration, two of the four alternatives were selected for further development: (1) NASA would oversee the development of a new reusable space launch system in coordination with the DoD, and (2) the Air Force, as executive agent for space launch for the DoD, would develop an EELV program. The EELV program concepts from four companies were evaluated during the first phase of the program. Alliant Techsystems Corporation, the Boeing Company, LMC, and McDonnell Douglas Astronautics Corporation (MDAC) all submitted concepts. After careful consideration, the LMC and MDAC EELV program concepts were found to best meet the objectives of the EELV program. Subsequent to this initial program phase, The Boeing Company purchased McDonnell Douglas Corporation. From that point, the MDAC system became known as the Boeing system.

Both EELV program concepts offered an evolved system engineered as a complete family of launch vehicles. Both featured a common core booster and other common vehicle elements, robust propulsion systems, enhanced manufacturing techniques, simplified standard launch operations, streamlined payload processing, and incorporation of advance launch system concepts.

Each company was awarded a Pre-Engineering and Manufacturing Development (Pre-EMD) contract to further define their programs and to reduce risk. The government would then, at the completion of the Pre-EMD phase, select one contractor to provide space launch services to the government through 2020. The government's position was subsequently modified, as described in Section 2.1.2.

2.1.2 Current EELV Program

In 1997, the Department of Commerce's COMSTAC predictions indicated that more launches would be performed for commercial satellites than for government satellites. COMSTAC predictions also showed a total increase in the number of launches from about 15 launches per year in a 1994 forecast to more than 30 launches per year in the 1997 forecast. The DoD, therefore, concluded that current forecasts meant sufficient demand would exist to support two EELV program concepts, and that sustained competition between commercial launch services providers would ensure cost-effective space launch for the government.

Based on these updated projections, the EELV program subsequently modified its approach by participating in the development of two commercial launch service capabilities. This option of a two-capability approach was subsequently addressed in the 1998 FEIS as "Concept A/B" along with "Concept A," which represented LMC, and "Concept B," which represented Boeing. The ROD for the 1998 FEIS, signed in April 1998, allowed the implementation of Concept A/B, the two-capability approach. In addition to contributing $500 million in development funds to each contractor, the Air Force is also providing land and infrastructure through long-term lease and license arrangements for launch facilities to be built by the EELV program contractors. Unlike previous programs, the Air Force will never own any EELV program flight hardware, equipment, or facilities. With the exception of the interface between the payload and the launch vehicle, the Air Force will not maintain configuration control over any part of the contractor's design.

The economies of total market integration and sustained competition are predicted to result in a 25 to 50 percent reduction in launch costs over the next 20 years, when compared to the currently flown Titan, Atlas, and Delta programs. A "clean-pad" concept will be followed that prepares the launch vehicle at facilities off the pad, thereby minimizing post-launch cleanup, maintenance, and turnaround time, while increasing throughput.

2.1.3 Proposed Action: Use of SRMs on the EELV Program

Both EELV program LVCs have proposed the use of solid-propellant strap-on rocket motors as an economical way to bridge the gap between their respective MLVs and HLVs. When attached to the core booster, these solid-propellant motors, commonly referred to as solid rocket motors, or SRMs, would increase the vehicle's overall performance by providing additional thrust during the initial boost phase. These SRMs generate thrust by burning propellant contained within a motor case. The principal components include propellant grain, igniter, motor case, exhaust nozzle, and mounting provisions. The case is lined with a rubber-like organic material coating, which ensures good bonding of the propellant grain and acts as a thermal insulator. The solid-propellant grain contains all of the chemical elements necessary for complete burning. Once ignited, the propellant burns smoothly at a predetermined rate on the exposed surface of the grain. After burnout, the SRMs separate from the core booster and fall into the ocean. The spent SRMs would not be recovered.

The Air Force's estimated EELV program launch manifest, including SRM-augmented launches, is shown on Table 2.1-1. The launch rates shown in the table are expected to represent the upper limit of potential SRM-augmented launches. The table was derived from the Air Force Space Command-developed National Mission Model (NMM) (a forecast of government launches), the latest version of the COMSTAC commercial space launch forecast, discussions with both EELV contractors, consultants from the Aerospace Corporation (a federally funded research and development center), and government launch experts. The table lists SRM-augmented launches for both LMC's Atlas V and Boeing's Delta IV systems. If the actual number substantially exceeds the launches forecast, additional environmental analysis would be conducted, as required under NEPA, AFI 32-7061, and DoD Regulation 5000.2R.

The EELV program launch manifest for the No-Action Alternative is shown on Table 2.1-2. The change in launch rates as a result of the Proposed Action is the difference between the Proposed Action and the No-Action Alternative, as shown in Table 2.1-3. This table displays positive values, where the number of Proposed Action launches would exceed the number of No-Action launches, and negative values, where the Proposed Action launches are fewer than the number of launches associated with the No-Action Alternative.

2.1.3.1 Atlas V System

Originally identified in the 1998 FEIS as "Concept A," the LMC family of vehicles is now referred to as the Atlas V system. Figure 2.1-1 shows the current set of Atlas V launch vehicles, including those proposed and analyzed under the 1998 FEIS and the new vehicle configurations that would use SRMs, evaluated in this FSEIS. The vehicles originally designated in the 1998 FEIS as the MLV-A and the HLV-G have been renamed and are now referred to as the Atlas V 300/400 and the Atlas V Heavy, respectively. For all Atlas V vehicles, LMC would use

TABLE 2.1-1
Launch Rates for EELV with the Proposed Action

Range	Family	Class	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
CCAFS	Atlas V	300/400	0	0	1	2	2	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
CCAFS	Atlas V	500	0	4	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	180
CCAFS	Delta IV	M	0	1	3	2	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25
CCAFS	Delta IV	M+	1	4	6	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	182
VAFB	Atlas V	300/400	0	0	1	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	10
VAFB	Atlas V	500	0	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	52
VAFB	Delta IV	M	0	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	8
VAFB	Delta IV	M+	0	1	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	54
CCAFS	Atlas V	Heavy	0	0	0	0	0	1	0	1	0	1	1	0	1	1	2	0	1	1	0	1	11
CCAFS	Delta IV	H	0	0	1	1	0	0	1	0	0	1	1	1	2	0	1	1	0	1	1	1	13
VAFB	Atlas V	Heavy	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	1	0	1	6
VAFB	Delta IV	H	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	1	0	0	1	0	6
CCAFS Total			1	9	17	26	23	25	23	23	22	24	24	23	25	23	25	23	23	24	23	24	430
VAFB Total			0	2	6	6	6	6	9	9	8	8	7	8	8	7	7	8	7	8	8	8	136
Total			1	11	23	32	29	31	32	32	30	32	31	31	33	30	32	31	30	32	31	32	566
Atlas CCAFS			0	4	7	12	12	11	11	12	11	12	12	11	12	12	13	11	12	12	11	12	210
Atlas VAFB			0	1	3	3	3	3	4	5	4	4	3	5	3	4	3	4	3	5	3	5	68
Atlas Total			0	5	10	15	15	14	15	17	15	16	15	16	15	16	16	15	15	17	14	17	278
Delta CCAFS			1	5	10	14	11	14	12	11	11	12	12	12	13	11	12	12	11	12	12	12	220
Delta VAFB			0	1	3	3	3	3	5	4	4	4	4	3	5	3	4	4	4	3	5	3	68
Delta Total			1	6	13	17	14	17	17	15	15	16	16	15	18	14	16	16	15	15	17	15	288
Total			1	11	23	32	29	31	32	32	30	32	31	31	33	30	32	31	30	32	31	32	566

Note: Proposed Action Delta IV M+ uses the GEM-60.
CCAFS = Cape Canaveral Air Force Station.
VAFB = Vandenberg Air Force Base.
H = Heavy-lift vehicles.
M = Medium-lift vehicle without SRMs.
M+ = Medium-lift vehicle with SRMs.
SRM = Solid rocket motor.

TABLE 2.1-2
Launch Rates for EELV Program with the No-Action Alternative

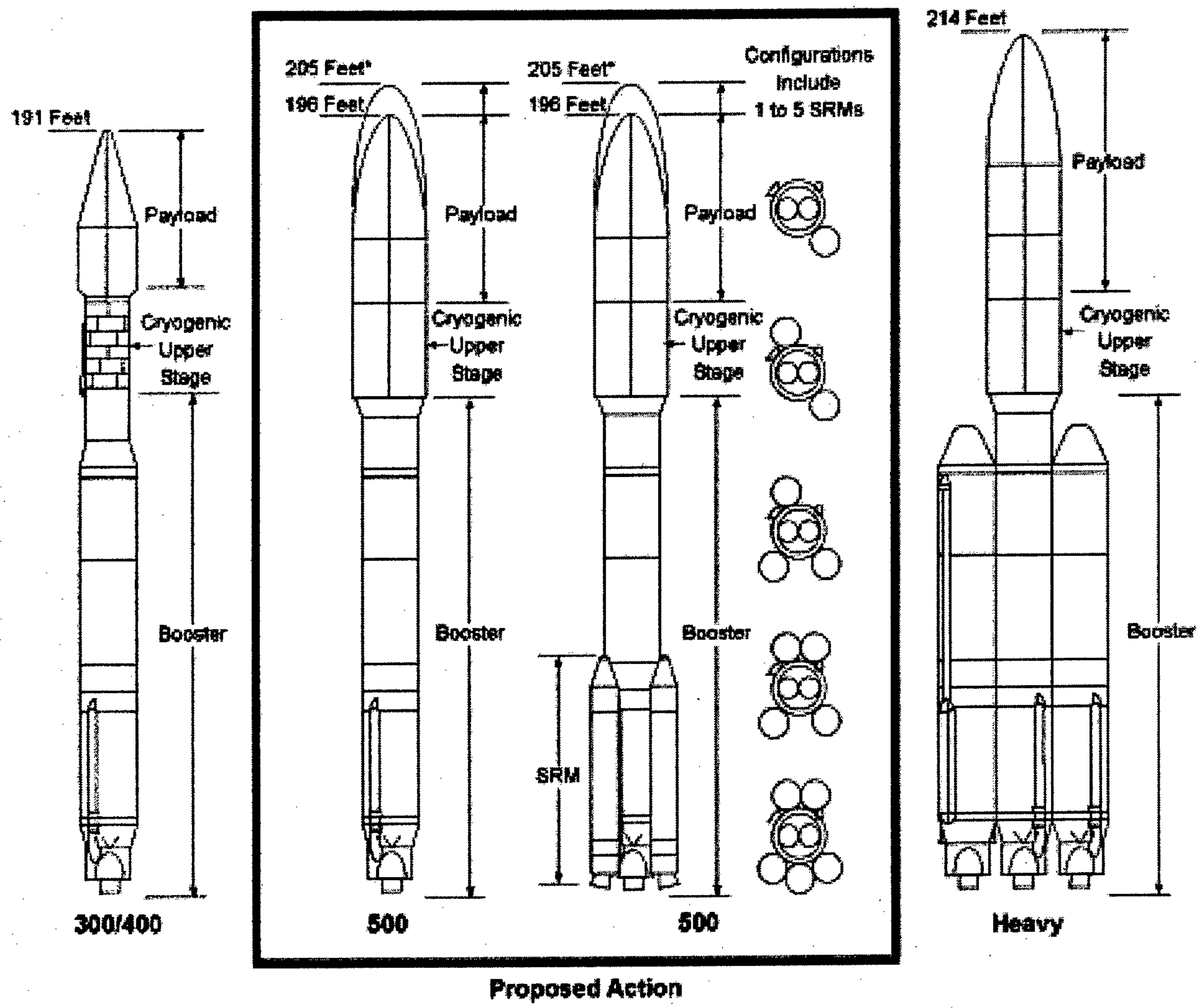
Range	Family	Class	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
CCAFS	Atlas V	300/400	0	3	3	8	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	157
CCAFS	Atlas V	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CCAFS	Delta IV	M	0	1	4	4	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	59
CCAFS	Delta IV	M+	1	3	2	4	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	103
VAFB	Atlas V	300/400	0	0	2	3	3	3	3	4	3	4	3	4	3	4	3	3	3	3	3	3	57
VAFB	Atlas V	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAFB	Delta IV	M	0	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	10
VAFB	Delta IV	M+**	0	0	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	50
CCAFS	Atlas V	Heavy	0	0	0	0	0	1	0	1	0	1	1	0	1	1	2	0	1	1	0	1	11
CCAFS	Delta IV	H	0	0	1	1	0	0	1	0	0	1	1	1	2	0	1	1	0	1	1	1	13
VAFB	Atlas V	Heavy	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	1	0	1	6
VAFB	Delta IV	H	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	1	0	0	1	0	6
	CCAFS Total		1	7	10	17	15	20	19	19	18	20	20	19	21	19	21	19	19	20	19	20	343
	VAFB Total		0	0	4	6	6	6	9	9	8	8	7	8	8	7	7	7	7	7	8	7	129
Total			1	7	14	23	21	26	28	28	26	28	27	27	29	26	28	26	26	27	27	27	472
	Atlas CCAFS		0	3	3	8	8	10	9	10	9	10	10	9	10	10	11	9	10	10	9	10	168
	Atlas VAFB		0	0	2	3	3	3	4	5	4	4	3	5	3	4	3	3	3	4	3	4	63
Atlas Total			0	3	5	11	11	13	13	15	13	14	13	14	13	14	14	12	13	14	12	14	231
	Delta CCAFS		1	4	7	9	7	10	10	9	9	10	10	10	11	9	10	10	9	10	10	10	175
	Delta VAFB		0	0	2	3	3	3	5	4	4	4	4	3	5	3	4	4	4	3	5	3	66
Delta Total			1	4	9	12	10	13	15	13	13	14	14	13	16	12	14	14	13	13	15	13	241
Total			1	7	14	23	21	26	28	28	26	28	27	27	29	26	28	26	26	27	27	27	472

** The Delta IV in the No-Action Alternative uses smaller SRMs than in the Proposed Action.
Note: No-Action Alternative Delta IV M+ uses GEM-46.
CCAFS = Cape Canaveral Air Force Station.
VAFB = Vandenberg Air Force Base.
H = Heavy-lift vehicles.
M = Medium-lift vehicle without SRMs.
M+ = Medium-lift vehicle with SRMs.
SRM = Solid rocket motor.

TABLE 2.1-3
Difference in Launch Rates for EELV Program between the Proposed Action and the No-Action Alternative

Range	Family	Class	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
CCAFS	Atlas V	300/400	0	-3	-2	-6	-6	-9	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-138
CCAFS	Atlas V	500	0	4	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	180
CCAFS	Delta IV	M	0	0	-1	-2	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-34
CCAFS	Delta IV	M+	0	1	4	7	6	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	79
VAFB	Atlas V	300/400	0	0	-1	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-2	-3	-2	-3	-2	-47
VAFB	Atlas V	500	0	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	52
VAFB	Delta IV	M	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
VAFB	Delta IV	M+	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CCAFS	Atlas V	Heavy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CCAFS	Delta IV	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAFB	Atlas V	Heavy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAFB	Delta IV	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CCAFS Total		0	2	7	9	8	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	87
	VAFB Total		0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	7
Total			0	4	9	9	8	5	4	4	4	4	4	4	4	4	4	5	4	5	4	5	94
	Atlas CCAFS		0	1	4	4	4	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	42
	Atlas VAFB		0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	5
Atlas Total			0	2	5	4	4	1	2	2	2	2	2	2	2	2	2	3	2	3	2	3	47
	Delta CCAFS		0	1	3	5	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	45
	Delta VAFB		0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Delta Total			0	2	4	5	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	47
Total			0	4	9	9	8	5	4	4	4	4	4	4	4	4	4	5	4	5	4	5	94

Note: Positive numbers indicate that the launch rates for the Proposed Action would exceed those of the No-Action Alternative; negative numbers indicate that launch rates for the Proposed Action are less than those for the No-Action Alternative.
CCAFS = Cape Canaveral Air Force Station, Florida.
VAFB = Vandenberg Air Force Base, California.
H = Heavy-lift vehicle.
M = Medium-lift vehicle without SRMs.
M+ = Medium-lift vehicle with SRMs.
SRMs = Solid rocket motors.



EXPLANATION

Notes:

- The Proposed Action would add the vehicle shown in the outlined box.
- Heights shown represent maximum vehicle height.
- * Two faring lengths shown.

SRM = Solid Rocket Motor

Atlas V Launch Vehicles

Figure 2.1-1

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launch facilities located at Space Launch Complex (SLC)-41 at CCAFS in Florida and SLC-3W at Vandenberg AFB in California.

2.1.3.1.1 Launch Vehicle Concept

Under the Proposed Action, LMC would add an additional group of vehicles to the EELV program, the Atlas V-500 Series. The Atlas V-500 Series vehicles shown in Figure 2.1-1 use the same core booster as the Atlas V-300/400 vehicles, but use up to five strap-on SRMs to improve mass-to-orbit capabilities. Each Atlas V vehicle is identified by a 3-digit number. The first number represents the diameter in meters of the payload fairing, which is a protective shroud surrounding the satellite during flight through the atmosphere. The second number identifies the number of SRMs, and the third number is the number of Centaur upper-stage engines. For example, an Atlas V-532 is similar to the Atlas V-401, but has a 5-meter versus a 4-meter payload fairing, uses three SRMs versus none, and has a Centaur upper stage with two engines versus a single engine. The Atlas V system core booster and Centaur upper stage were analyzed in the 1998 FEIS.

Figure 2.1-2 shows a representative ascent sequence for an Atlas V with SRMs. Up to five SRMs would be used for each Atlas V-500. Even though fewer SRMs may be used on some launches, the maximum number of SRMs is shown and analyzed. This assumption applies to all other figures of the Atlas V system in this document. After the launch, expended SRMs would fall into the ocean and would not be recovered. No trawling or recovery activities would occur. This procedure would be similar to the No-Action Alternative, under which the expended liquid-fueled boosters are not recovered.

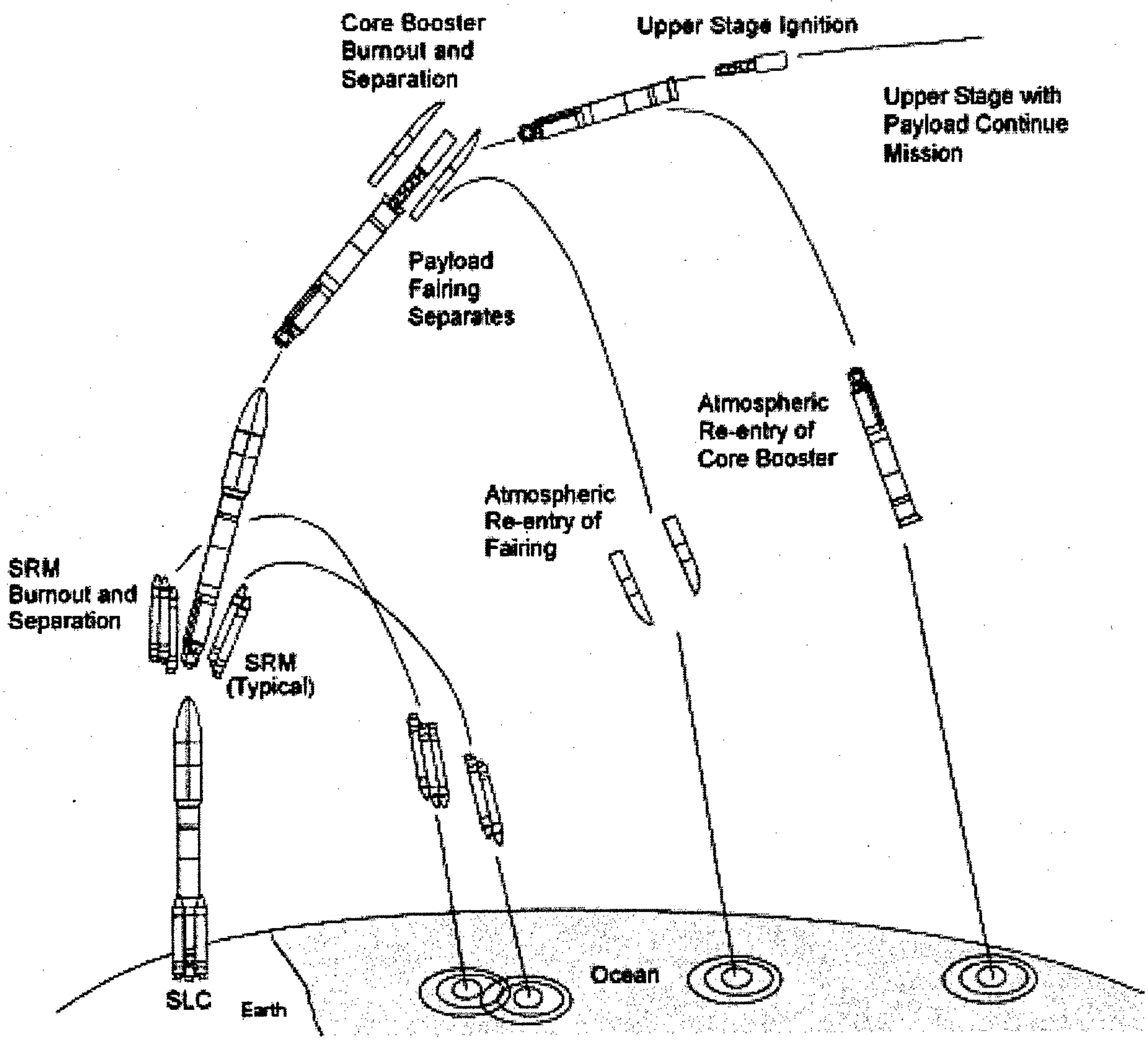
Figure 2.1-3 shows how the SRMs would be integrated with the other vehicle components at the launch pad and Table 2.1-4 summarizes the propulsion characteristics of the core booster, SRMs, and upper stage used on Atlas V vehicles.

TABLE 2.1-4
Propulsion Characteristics, Atlas V*

Launch Vehicle Component	Launch Vehicle Quantity	Propellant	Fueling Location	Reaction Control System	RCS Loading Location
Booster	Atlas V-300 (1) Atlas V-400 (1) Atlas V-500 Series (1) Atlas V-Heavy (3)	RP-1 <200,000 lbs LO_2 <500,000 lbs PG-2 <100 lbs	Launch Pad	NA	NA
SRM	Atlas V-500 Series V (up to 5)	NH_4ClO_4 64,000 lbs Al 18,000 lbs HTPB 12,300 lbs	Manufacturer	NA	NA
CUS	All Atlas V vehicles (1)	LH_2 <8,000 lbs LO_2 <40,000 lbs	Launch Pad	N_2H_4 300/400/500 <200 lbs Heavy <400 lbs	Assembly Facility

Al = Powdered aluminum (fuel).
CUS = Cryogenic Upper Stage.
HTPB = Hydroxyl-terminated polybutadiene (binder).
LH_2 = Liquid hydrogen.
LO_2 = Liquid oxygen.
NA = Not applicable.
NH_4ClO_4 = Ammonium perchlorate (oxidizer).
N_2H_4 = Anhydrous hydrazine.
PG-2 = Triethyl boron/triethyl aluminum.
RCS = Reaction control system.
RP-1 = Rocket propellant-1 (kerosene fuel).
SRM = Solid rocket motor.

*Numbers in parentheses reflect the quantity of component per vehicle type.



EXPLANATION

SLC	Space Launch Complex
SRM	Solid Rocket Motor

NOT TO SCALE

Atlas V 500 Series Representative Ascent Sequence

Figure 2.1-2

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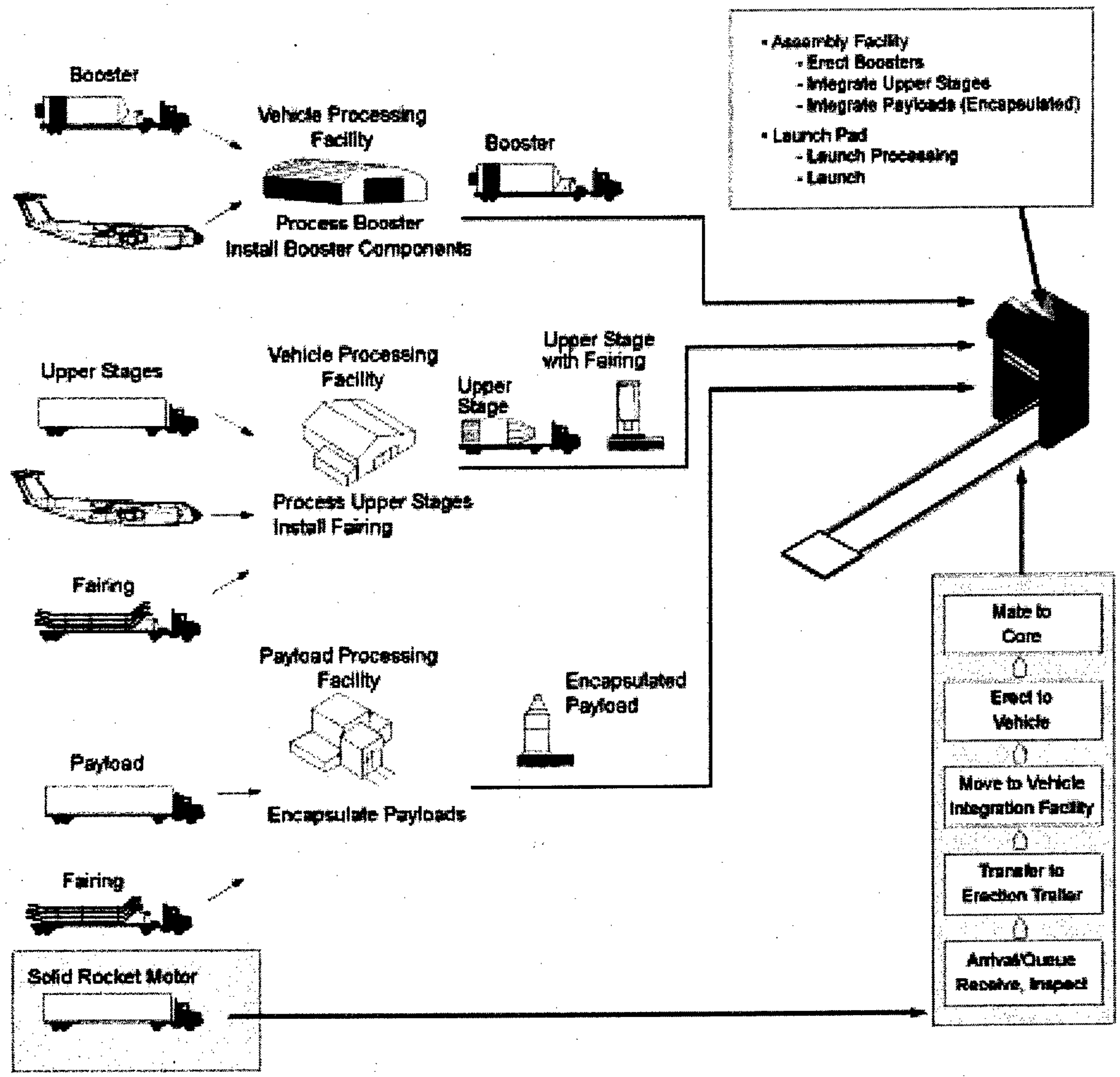

Atlas V 500 Series Launch Operation

Figure 2.1-3

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Each SRM would be approximately 64 feet long and 62 inches in diameter, with an approximate overall mass of 102,500 pounds (including approximately 94,000 pounds of propellant). The filament-wound motor case would be made of carbon fiber/epoxy, and the exhaust nozzle would be made of carbon phenolic and steel. The solid propellant would consist of ammonium perchlorate (NH_4ClO_4), powdered aluminum (Al), and hydroxyl-terminated polybutadiene (HTPB).

2.1.3.1.2 Primary Support Facilities

Various support structures and equipment are necessary to process and launch the Atlas V family of launch vehicles. Most of these were analyzed in the 1998 FEIS and allowed for implementation by the ROD. Some new facilities and equipment, however, would be required to handle the incorporation of SRMs into the Atlas V family. This document identifies facility requirements for the use of SRMs at both launch sites (SLC-41 at CCAFS and SLC-3W at Vandenberg AFB).

A comprehensive list of primary support facilities used by the Atlas V system at CCAFS is shown in Table 2.1-5. This table includes all facilities at CCAFS that would be used for Atlas V operations, including those proposed for use in support of SRM activities. The route to be used to deliver SRMs to CCAFS is shown in Figure 2.1-4, including the route the SRM-transport vehicles would follow to SLC-41. Figure 2.1-5 illustrates the launch pad. SRMs are scheduled for just-in-time delivery, but SLC-41, SLC-11, and the Solid Motor Assembly and Readiness Facility (SMARF) may be used for temporary storage and staging, as necessary. The support facilities used by the Atlas V system at Vandenberg AFB are shown on Table 2.1-6. This table includes all facilities at Vandenberg AFB used for Atlas V operations, including those proposed for use in support of SRM activities. The route to be used to deliver SRMs to Vandenberg AFB is shown in Figure 2.1-6, including the route the SRM-transport vehicles would follow to SLC-3W. Figure 2.1-7 illustrates the launch pad. Building 960 may be used for temporary storage and staging of SRMs, as necessary.

Unloading Facilities. No unloading facilities are required for the handling of SRMs at either launch site. For Atlas V-500 Series launches, the SRMs would be delivered via truck from the manufacturer (Aerojet in Sacramento, California) to SLC-41 at CCAFS and to SLC-3W at Vandenberg AFB. After arriving at the respective launch pads, the SRMs would be taken to the Vehicle Integration Facility (VIF) and transferred to an erection trailer.

Staging/Storage Facilities. As described above, Atlas V-500 Series launch processing depends on a just-in-time delivery concept. The SRMs are delivered directly to the launch complex and staged or stored under the existing lightning mitigation systems until processing schedule allows delivery (one at a time) to the VIF. Consequently, no long-term SRM storage is necessary. Launch delays could occur under the following scenarios: (1) before SRM shipment, (2) after shipment but before mating to the launch vehicle, or (3) after mating to the launch vehicle. In scenario 1, the SRM shipment would be delayed. In scenario 2, the SRMs would be temporarily stored in their shipping containers on the pad deck or at one of the specified short-term contingency storage sites. In scenario 3, if the delay required de-mating, the SRMs would also be temporarily stored on the pad deck or at a specified short-term contingency storage site. In either scenario 2 or 3, if the delay became extensive, the SRMs would be shipped back to the supplier for long-term storage.

TABLE 2.1-5
Support Facilities, Cape Canaveral Air Force Station, Atlas V with SRMs

Common Support Structure	Facility	Operation
Aircraft Unloading	CCAFS Skid Strip [a]	Receive Upper Stage/Booster
Storage	Building 1721 (Hangar J) [a]	Store Launch Vehicle Elements
	Building 70500 (Vehicle Integration Building (VIB) Annex) [a]	
	Building 75251 (Missile Inert Storage) [a]	
Office Space	Building 70510 (Integrate Transfer Launch (ITL) Building) [a]	Administration
Vehicle Processing Facility	Building 1721 (Hangar J) [a]	Receive and Check Out Vehicle Elements, Process Elements
Payload Processing Facilities	Building 70000 Annex (Spacecraft Processing Integration Facility (SPIF)) Spacecraft Processing Center (New Construction) [a]	Encapsulate Payload, Receive, inspect, process payload. Perform final assembly and checkout. Load storable propellant. Encapsulate payload.
	Building 55820 (Defense Satellite Communications System (DSCS) Processing Facility (DPF)) [a]	
Refurbishment Area	Building 70665 (VIB Parking Area) [a]	Refurbish Mobile Launch Platform (MLP)
	Vehicle Integration Facility (VIF) [a]	
Assembly Facilities	Vehicle Integration Facility (VIF) [a]	Integrate Launch Vehicle, Conduct Integrated System Test
	Building 69800 (Solid Motor Assembly and Readiness Facility (SMARF)) [b]	Integrate Launch Vehicle, Conduct Integrated System Test
Launch Complex	SLC-41 [a]	Launch Countdown, Post Launch Countdown
Launch Control Support	Building 27220 (Launch Operations Control Center (LOCC)) [a]	Launch Countdown, Launch
Propellant and Gas Holding Areas	SLC-41 [a]	Launch Vehicle Fueling, Pressure Testing
	SLC-11	**Solid Rocket Motor Contingency Storage**
	Building 69800 (SMARF) [b]	Solid Rocket Motor Contingency Storage
Operations Center	Building 75251 (Missile Inert Storage (MIS) [a] Atlas V Spaceflight Operations Center (ASOC) and Diesel Fuel Tank	Vehicle Receipt, Inspection, Initial Checkout, Install Minor Ordnance, Launch Control Center, Communications Center, Administration Offices, Battery Lab, Mission Director Center, Material Crib
	Building 75253 MIS Lift Station [b]	Sewage Treatment
	Building 75256 MIS Nitrogen Storage Area [b]	Nitrogen Storage
	Building 75257 MIS Substation [b]	Supply Power
	Building 75285 MIS POL [b]	Storage: Petroleum, Oil, and Lubricants

[a] Support facility addressed in the 1998 FEIS.
[b] Support facility not addressed in the 1998 FEIS, but will be used for both the Proposed Action and the No-Action Alternative in this FSEIS. No facilities will require modification except for the SMARF, which will require internal modifications only.

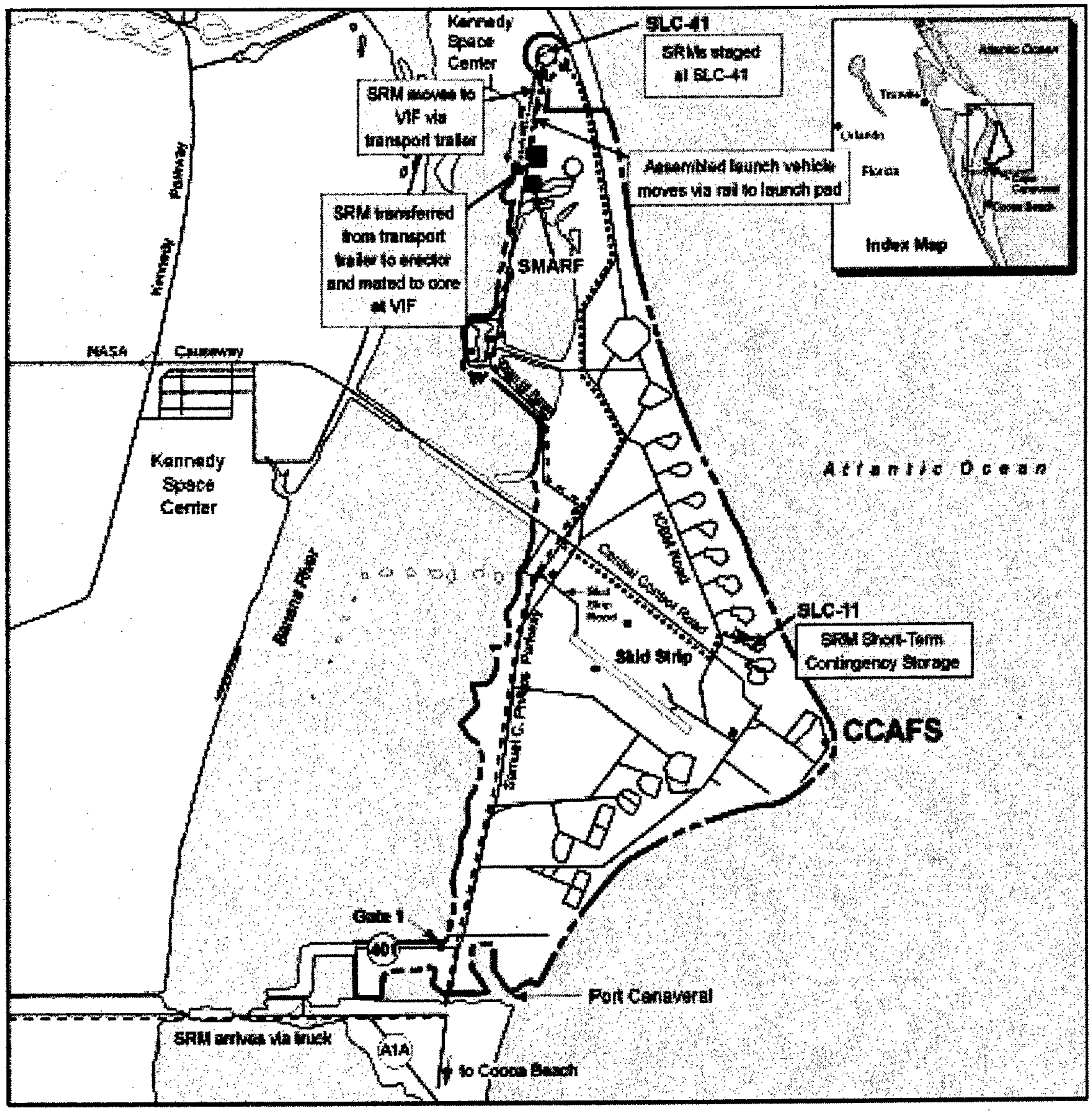
SLC-11 will be used for the Proposed Action only. No new land disturbance is necessary.

TABLE 2.1-6
Support Facilities, Vandenberg AFB, Atlas V with SRMs

Common Support Structure	Facility	Operation
Aircraft Unloading	Vandenberg AFB Airfield [a]	Receive Upper Stage/Booster
Storage	Building 7525 (Booster Assembly Building (BAB)) [a]	Store Launch Vehicle Elements
	Building 8337 (Payload Fairing Processing Facility) [a]	Refurbish/ preparation for fairing, cleaning, carbon dioxide (CO_2) robot cleaning
	Building 790 [b]	Storage/warehouse
Office Space	Building 8401[a]	Administration
	Building 5500 [b]	Administration, Storage/warehouse
	Building 8304 (Fabricate, modify small hardware (FMS)) [b]	Fabricate, modify small hardware
	Building 8305 (FMS) [b]	Fabricate, modify small hardware
	Building 761 [b]	Administration
Vehicle Processing Facility	Building 7525 (BAB) [a]	Receive and Check Out Vehicle Elements, Process Elements
Payload Processing Facilities (Proposed Payload Facilities)	Building 375 (Integrated Processing Facility (IPF)) [a]	Encapsulate Payload
	Building 1032 (Astrotech) [a]	Encapsulate Payload
	Building 2520 (Payload Processing Facility (PPF)) [a]	Payload Processing
Assembly Facilities	Vehicle Integration Facility (VIF)[a]	Integrate Launch Vehicle, Conduct Integrated System Test
Launch Complex	SLC-3W [a]	Launch Countdown, Post Launch Countdown
Launch Control Support	Building 8510 (Remote Launch Control Center (RLCC)) [a]	Launch Countdown, Launch
	Building 763 Launch Operations Building[b]	Communication
Propellant and Gas Holding Areas	SLC-3W [a]	Launch Vehicle Fueling, Pressure Testing
	Building 960	**Solid Rocket Motor Contingency Storage**

[a] Support facility addressed in the 1998 FEIS.
[b] Support facility not addressed in the 1998 FEIS but will be used for both the Proposed Action and the No-Action Alternative. No modifications are necessary

Building 960 will be used for the Proposed Action only. No new land disturbance is necessary.



EXPLANATION

- - - -	Station Boundary
(A1A)	State Route
- - - - -	SRM Route (normal)
....	SRM Route (contingency)
....	SRM Route (trailer to VIF)
—·—·—	SRM Route (rail to launch pad)

VIF Vehicle Integration Facility
SRM Solid Rocket Motor

0 3000 6000 12000 Feet

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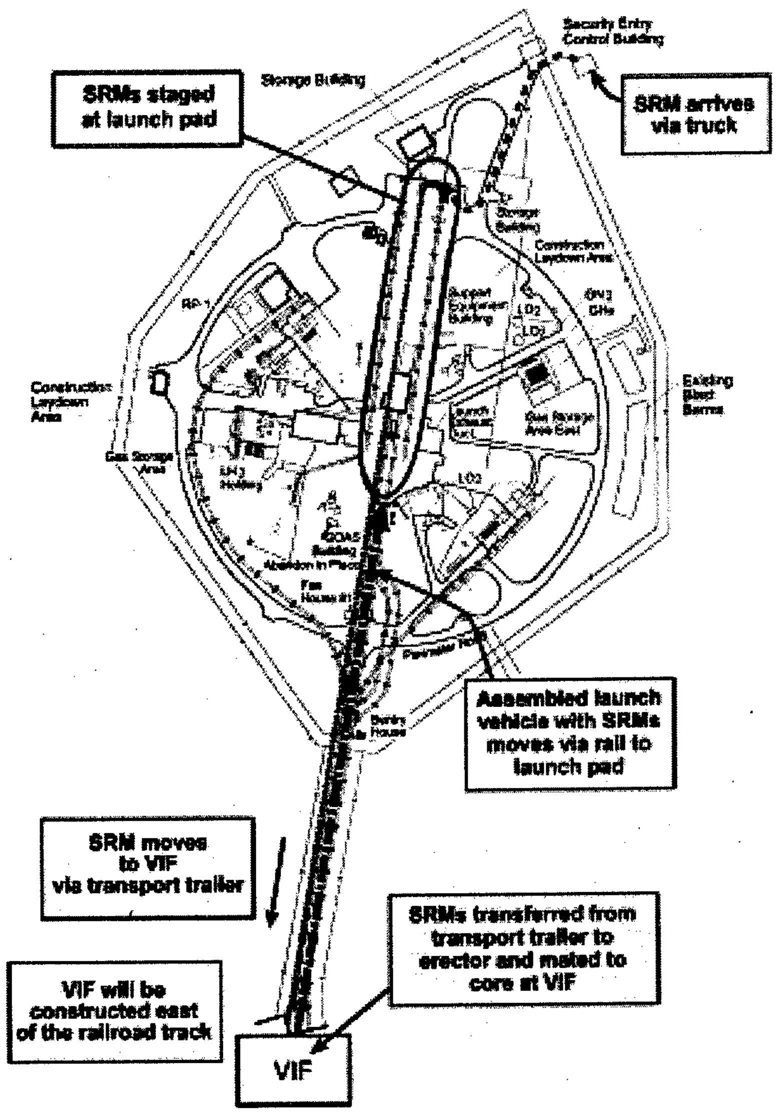
Atlas V 500 Series Transport Route CCAFS, Florida

Figure 2.1-4



EXPLANATION

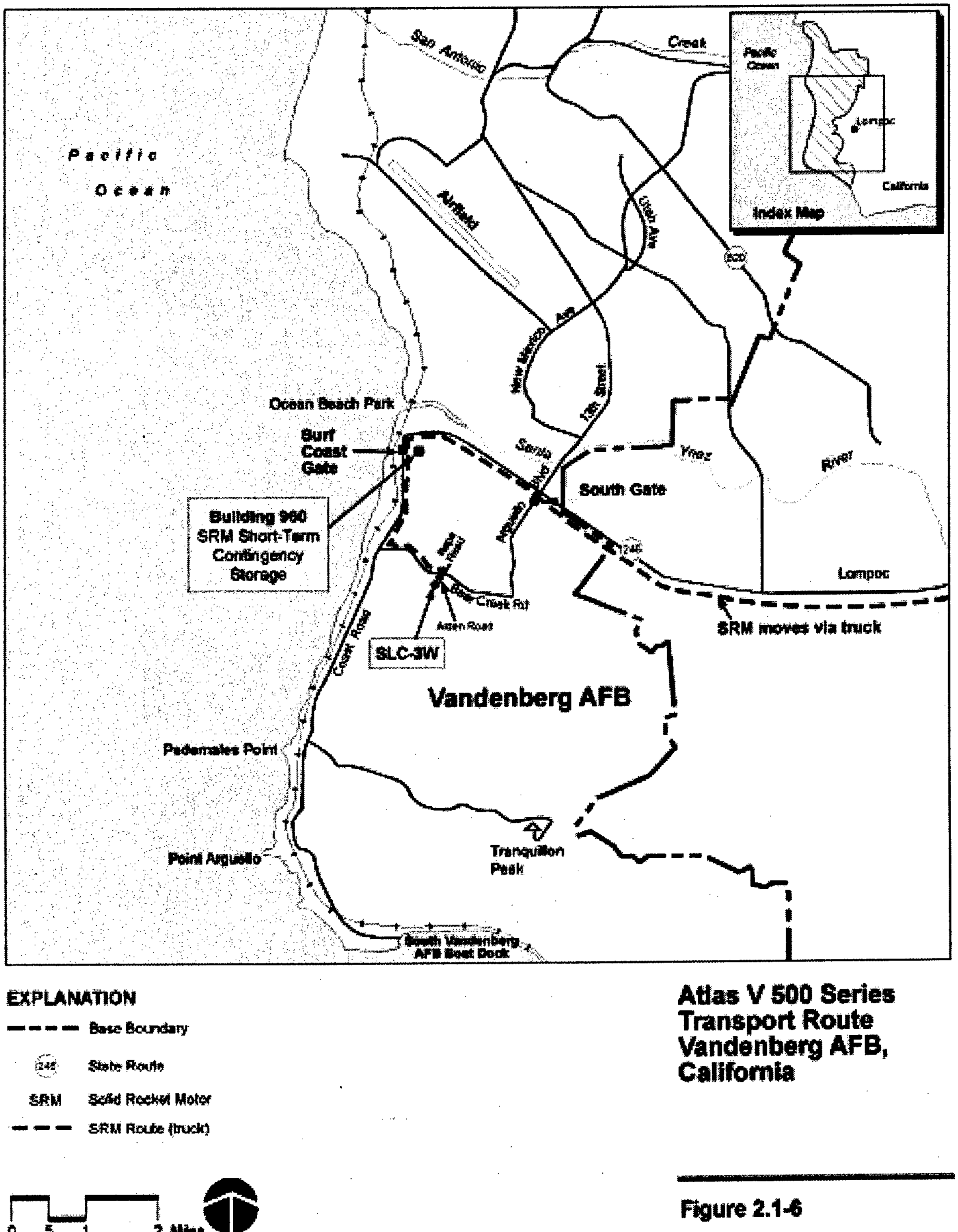
GHe	Gaseous Helium
GN2	Gaseous Nitrogen
LH2	Liquid Hydrogen
LO2	Liquid Oxygen
RP-1	Rocket Propellant-1 (Kerosene Fuel)
VIF	Vehicle Integration Facility
SRM	Solid Rocket Motor

Security Fence
SRM Route (trailer to Bldg. 70500)
SRM Route (rail to launch pad)
SRM Route (normal)

0 150 300 Feet

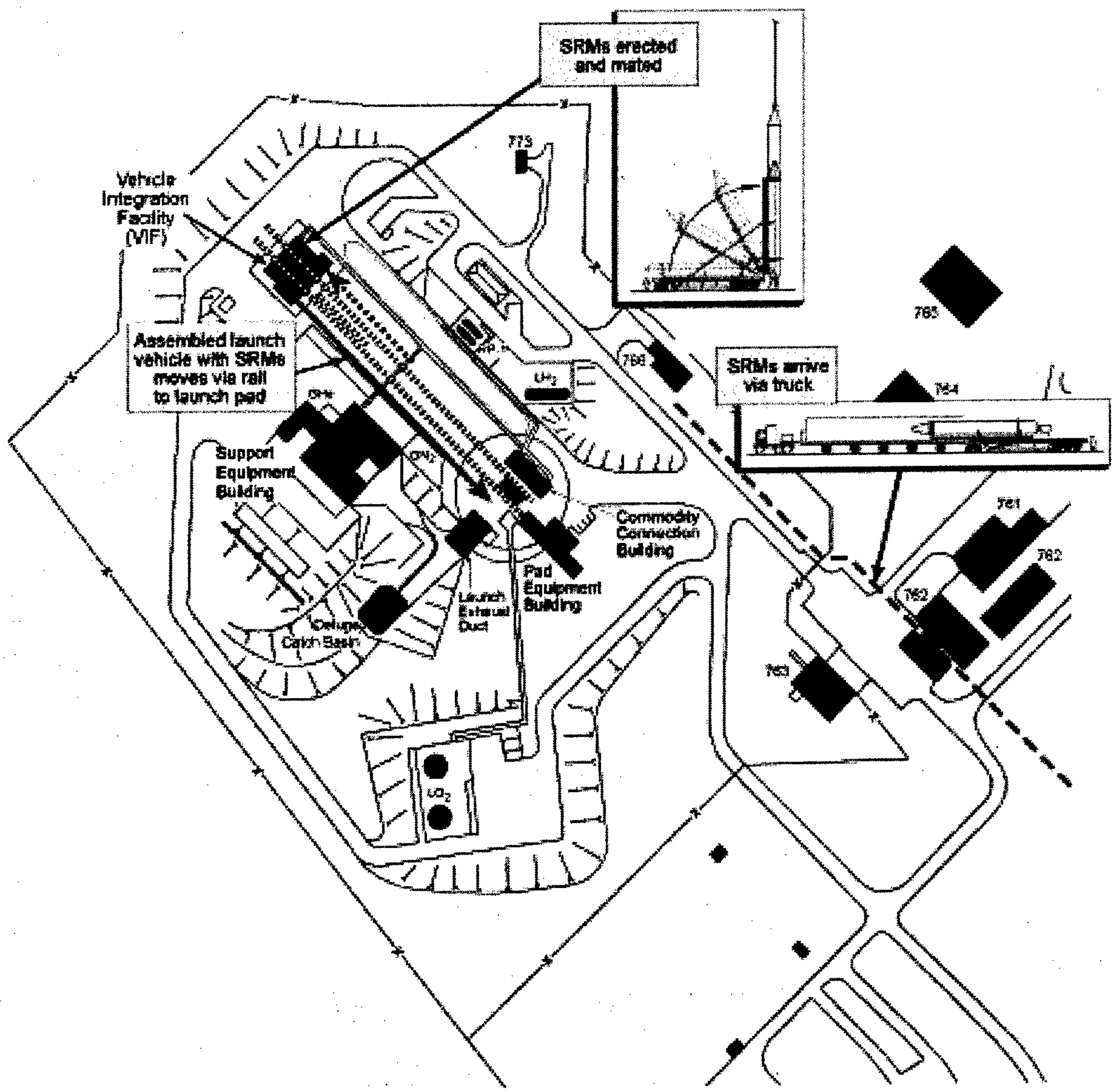
Atlas V 500 Series SLC-41 Site Plan and Flow CCAFS, Florida

Figure 2.1-5



Atlas V 500 Series Transport Route Vandenberg AFB, California

Figure 2.1-6



EXPLANATION

GHe	=	Gaseous Helium	
GN_2	=	Gaseous Nitrogen	
LH_2	=	Liquid Hydrogen	
LO_2	=	Liquid Oxygen	
RP-1	=	Rocket Propellant-1 (Kerosene Fuel)	
SRM	=	Solid Rocket Motor	

- Electrical Line
- Embankment
- SRM Route (truck)
- SRM Route (transport trailer)
- SRM Route (rail)

0 60 120 240 Feet

Atlas V 500 Series SLC-3W Site Plan and Flow Vandenberg AFB, California

Figure 2.1-7

At CCAFS, the short-term contingency storage location would be on the pad deck at SLC-41, or at SLC-11. Preliminary approval for SLC-41 siting has been obtained. A maximum of five SRMs would be staged at either site. SLC-11 has been sited and approved for these types of operations for up to 6 months, as analyzed in the Atlas II-AS Environmental Assessment (EA) and the executed Finding of No Significant Impact (FONSI). SLC-11 is an open pad already sized to handle up to 111,750 pounds of Class 1.3 explosives and would not need to be modified. An optional short-term contingency storage location would be SMARF, which is currently used by the Titan IV program, but would become available for processing Atlas V SRMs in 2003.

At Vandenberg AFB, SLC-3W has been approved to handle up to 52,000 pounds of Class 1.1 explosives and would not need to be modified. The short-term contingency storage location would be Building 960. A maximum of five SRMs would be held at Building 960. This facility already has been sized to handle up to 20,000 pounds of Class 1.1 explosives and would not need to be modified.

Vehicle Processing Facilities (VPF). The SRMs would be delivered directly from the manufacturer to the unloading/staging locations at the launch complex. No SRM processing would take place at either CCAFS or Vandenberg AFB.

Assembly Facilities (VIF). No external changes to the existing facilities are required at either launch site. After the SRMs are moved from the launch pad to the VIF, they would be attached to the core booster on the mobile launch platform (MLP), while it is parked in the VIF. This process uses a special-purpose vehicle that supports and elevates the SRM to a vertical position. The SRM is then lifted into place by an overhead crane and mated to the core vehicle. Following assembly, the MLP would be moved to the launch pad for core booster propellant loading, final checkout, and launch. The attachment of the SRMs in the VIF represents the only change in the assembly process from the No-Action Alternative analyzed in the 1998 FEIS.

To support the Atlas V 500 Series, the contractor would be performing design modifications within the VIF. These modifications could include, but would not be limited to, modifications of cranes, access platforms, platforms, tiedowns, and electrical and mechanical systems.

Operational support of the Atlas V 500 Series would require the periodic replacement of structural members, electrical and mechanical systems, minor structural modifications, routine corrosion control, painting, and other maintenance activities at the VIF and at other SRM-related facilities, which are considered part of this Proposed Action. These operational support activities would all occur within the fence line of each facility.

2.1.3.1.3 Launch Site Operations

Launch site operations for the Atlas V-300/400 and Atlas V-Heavy were outlined in the 1998 FEIS and remain unchanged (see Figure 2.1-3). Modifications to launch operations resulting from the addition of SRMs are outlined below.

Component Receipt and Check-Out. As described above, the SRMs would be shipped directly from the manufacturer in Sacramento, California, to the launch site. The motors would be transported via a tractor-trailer with each vehicle carrying a single motor. The tractor-trailers would follow routes approved by the U.S. Department of Transportation (DOT) and would adhere to all applicable federal and state highway transportation safety measures.

For delivery to CCAFS, the SRMs would enter through Gate 1 from State Route (SR) 401 (Figure 2.1-4). The transporters would then proceed along an Air Force-controlled secondary roadway, Samuel C. Phillips Parkway, to Titan III Road. From here, the route would travel north and through the South Gate to SLC-41. If contingency storage is necessary, the SRMs would be transported to SLC-11 by departing through the South Gate of SLC-41 to Samuel C. Phillips Parkway, to Central Control Road. From here, the transport would be to ICBM Road and into SLC-11. If the SMARF is used for storage, the SRMs would travel from the South Gate of SLC-41 to Titan III Road.

Delivery to Vandenberg AFB would be through Surf Coast Gate via SR 246 onto Air Force-controlled secondary roadways, Coast Road, to Napa Road, to SLC-3W (Figure 2.1-6). If short-term contingency storage is necessary, the route would be SLC-3W to Coast Road, then north on Coast Road to Building 960.

After delivery, the SRMs would be visually inspected to verify that no out-of-specification conditions exist as a result of transportation to the site. These activities are in addition to the vehicle component checkout activities that would occur under the No-Action Alternative. Changes in hazardous materials used during launch operations as a result of the use of additional SRMs are described in Section 4.6.

The manufacturer would perform nondestructive evaluation (NDE) of the SRMs at its own facility prior to shipment. NDE can include x-ray or ultrasound analysis and would be performed to ensure that no irregularities exist in the SRM. LMC may decide to perform limited NDE at both CCAFS and Vandenberg AFB. If limited NDE were required at either site, LMC would expect to use existing facilities, so no new ground disturbance would be necessary.

Launch Vehicle Integration. After delivery of the SRMs to the launch site, the motors would be mounted to the core booster in the VIF. There would be no other change in launch vehicle integration.

Launch Sequence. The SRMs would be ignited shortly after the core booster main engine starts. Following liftoff, the SRMs would continue to burn until the propellant is depleted (approximately 95 seconds). Following burnout, the motor cases would stay attached to the core booster for as long as necessary to ensure that the expended motors do not impact land. Following this delayed release, the spent SRMs would fall into the ocean and would not be recovered.

The Atlas V-500 Series vehicles would require the same amount of launch-pad deluge and washdown water for cooling and acoustic dampening as the Atlas 300/400 and Atlas V-Heavy. During preparation of the 1998 FEIS, a maximum per-launch water usage of 59,000 gallons was estimated to be necessary for the Atlas V launches. These values were based on the requirements of similar launch vehicles. More definitive design data now indicate a maximum need for 600,000 gallons per launch, of which 300,000 gallons would be captured in the launch exhaust duct. This corrected amount of water usage would be required both for the No-Action Alternative, as well as for the Proposed Action launches.

The current disposal method for the launch pad washdown water at Vandenberg AFB is to pump the water into tank trucks, each with a capacity of approximately 5,000 gallons. The water is then trucked offsite for treatment and disposal. The original assumption, that 40,000 gallons of water would be removed from the Vandenberg AFB launch pad site,

would have required approximately 8 trucks per launch. The revised quantity of water would require approximately 60 truck trips per launch at Vandenberg AFB. At CCAFS, the wastewater would be discharged in accordance with the Florida Department of Environmental Protection (FDEP) Industrial Wastewater Permit.

Post-Launch Activities. As a result of the additional SRMs, the composition of the retained deluge washdown water, generated during and immediately following the launch, would change from the No-Action Alternative. The water would contain low concentrations of HCl and Al_2O_3 from the SRM exhaust. This change in water composition is addressed in the Water Resources section of this document (Section 4.9).

System Safety. System safety includes procedures for short-term contingency storage of SRMs and range safety. System safety is addressed in the Health and Safety section of this document (Section 4.7).

2.1.3.2 Delta IV System

Originally identified in the 1998 FEIS as "Concept B," the Boeing family of vehicles is now referred to as the Delta IV system. Figure 2.1-8 shows the Delta IV launch vehicles that are part of the current No-Action Alternative, as well as the new vehicle configuration that would use larger SRMs, which is evaluated in this FSEIS. The vehicles without SRMs are the Delta IV-M and the Delta IV-H systems. Boeing also identified an SRM-augmented vehicle in the 1998 FEIS, the Delta IV-M+. Subsequent to the 1998 FEIS, Boeing decided to increase the size of the SRMs used on the Delta IV-M+. For all vehicles in the Delta IV family, Boeing would use launch facilities located at SLC-37 at CCAFS and SLC-6 at Vandenberg AFB.

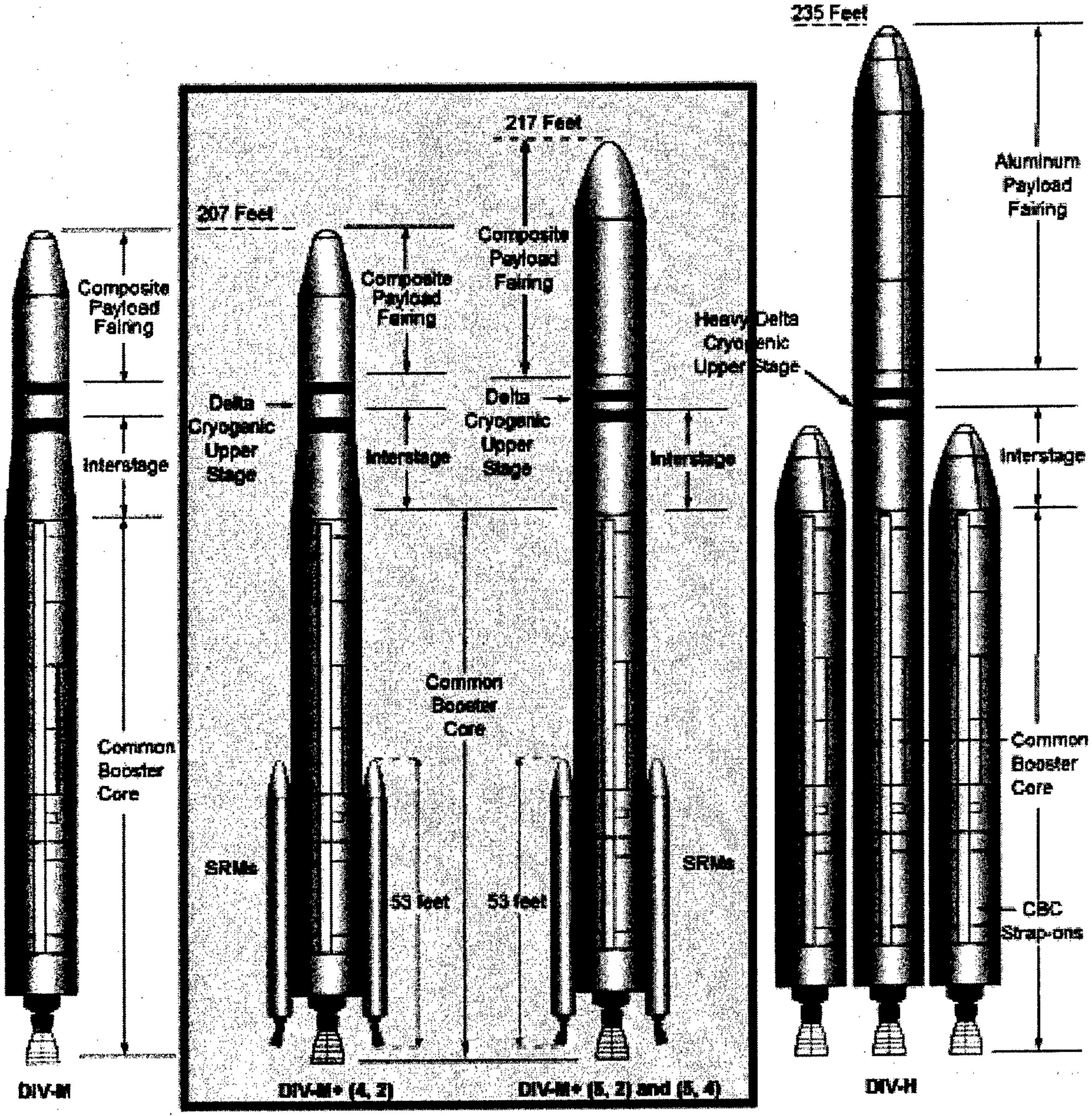
2.1.3.2.1 Launch Vehicle Concept

Under the Proposed Action, Boeing would increase the size of the SRMs used on the Delta IV M+ to increase performance so that heavier payloads could be delivered with an MLV. There are two versions of the proposed Delta IV M+: one using two SRMs and the other using four SRMs. Both vehicles would use the same common booster core as the Delta IV-M system that was previously analyzed in the 1998 FEIS. Figure 2.1-8 shows both configurations of the Delta IV M+. Delta IV M+ vehicles are distinguished by two numbers in the name. The first number represents the payload fairing diameter in meters and the second number identifies the number of SRMs. For example, the Delta IV-M+ (4,2) has a 4-meter-diameter payload fairing and uses two SRMs.

Figure 2.1-9 shows a representative launch vehicle ascent sequence for a Delta IV M+ vehicle. Either two or four SRMs, initially attached to the common booster core, separate following burnout and fall into the ocean. The spent rocket motor cases would not be recovered.

Figure 2.1-10 shows how the SRMs would be integrated with the other facility components at the launch pad. Table 2.1-7 summarizes the propulsion characteristics of the common booster core, SRMs, and upper stage used on Delta IV vehicles.

Boeing's new SRMs would be substantially larger than those addressed in the 1998 FEIS. The new SRMs would have a length of approximately 53 feet, a diameter of 60 inches, and an overall mass of roughly 74,500 pounds. The SRM case would be constructed from filament-wound graphite epoxy. The motor designation (GEM-60, or graphite epoxy



EXPLANATION

CBC = Common Booster Core
DIV = Delta IV
DIV-H = Heavy-Lift Vehicle
DIV-M = Medium-Lift Vehicle
DIV-M+ = Medium-Lift Vehicle with SRMs
SRM = Solid Rocket Motor

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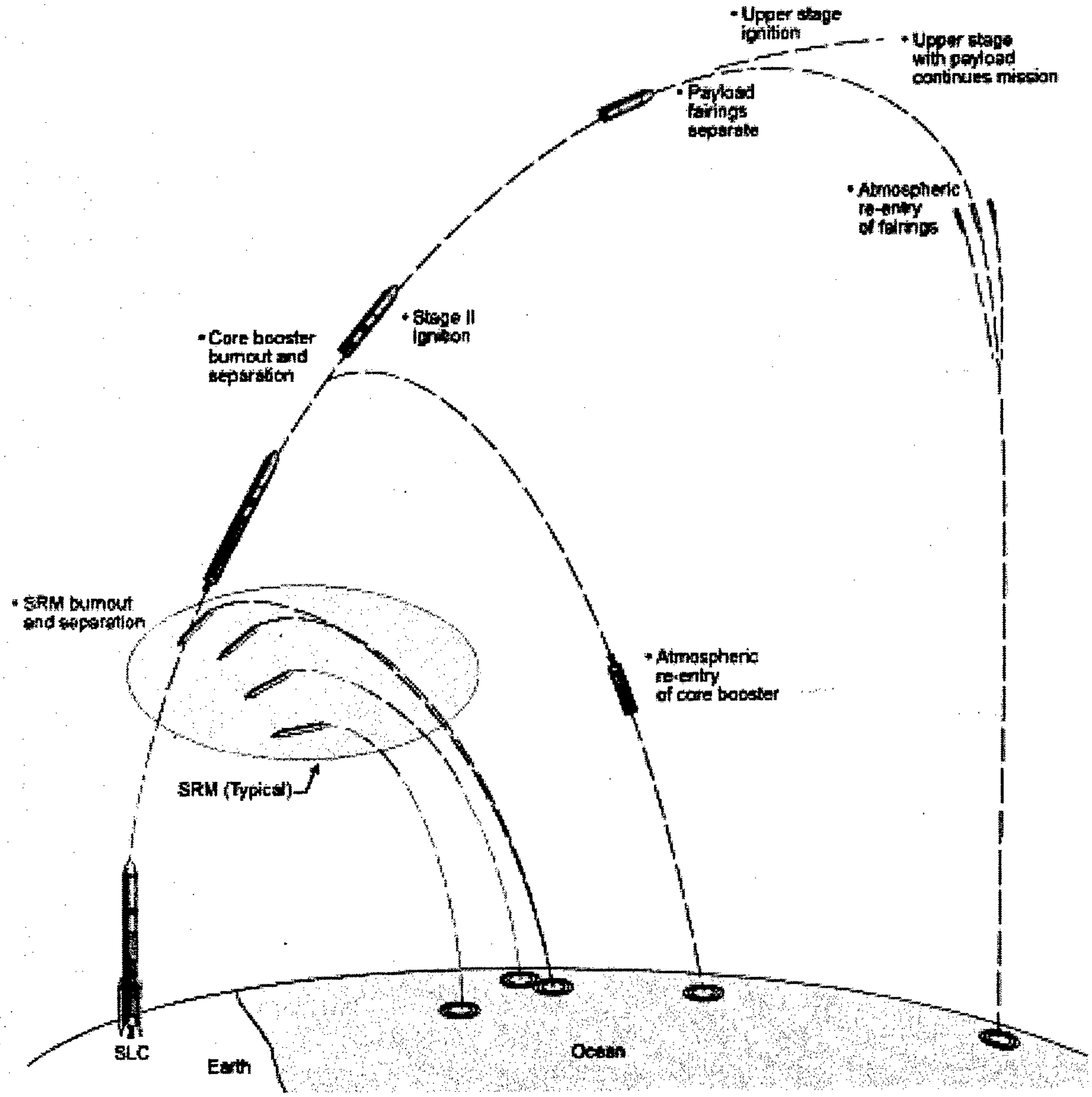
Delta IV Launch Vehicles

Figure 2.1-8



EXPLANATION

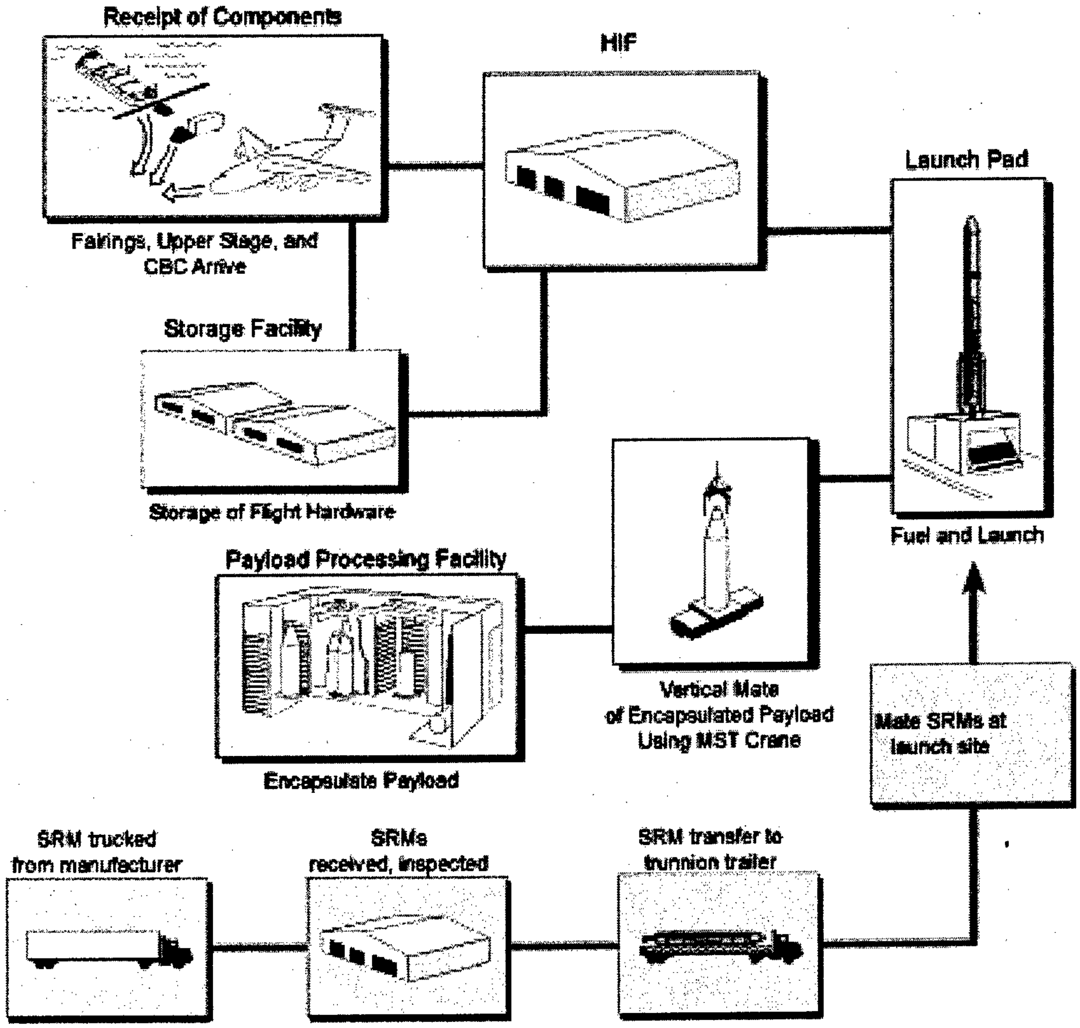
SLC = Space Launch Complex

SRM = Solid Rocket Motor

Delta IV M+ Representative Ascent Sequence

NOT TO SCALE

Figure 2.1-9



EXPLANATION

CBC = Common Booster Core
HIF = Horizontal Integration Facility
MST = Mobile Service Tower
SRM = Solid Rocket Motor

Delta IV M+ Launch Operations

Figure 2.1-10

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TABLE 2.1.-7
Propulsion Characteristics, Delta IV

Launch Vehicle Component	Launch Vehicle Quantity	Propellant	Fueling Location	Reaction Control System	RCS Loading Location
CBC	DIV M, DIV M+, and DIV H	LH_2 (<63,000 lbs) LO_2 (<387,000 lbs)	Launch Pad	NA	NA
DCUS	DIV M	LH_2 (<7,000 lbs) LO_2 (<40,000 lbs)	Launch Pad	N_2H_4 (160 lbs) He(1 lb)	Launch Pad
HDCUS	DIV H	LH_2 (<9,000 lbs) LO_2 (<55,000 lbs)	Launch Pad	N_2H_4 (320 lbs) He (2 lbs)	Launch Pad
SRM[a]	DIV M+	NH_4ClO_4 (44,550 lbs) Al (12,450 lbs) HTPB (4,800 lbs)	Manufacturer	NA	NA

[a]Propellant weight shown is for an individual SRM.

Al = aluminum.
CBC = Common booster core.
DCUS = Delta Cryogenic Upper Stage.
DIV = Delta IV.
DIV H = Heavy-lift vehicle.
DIV M = Medium-lift vehicle.
DIV M+ = Medium-lift vehicle with SRMs.
HDCUS = Heavy Delta Cryogenic Upper Stage.
He = helium.
HTPB = hydroxyl-terminated polybutadiene (binder material).
lbs = Pounds.
LH_2= Liquid hydrogen.
LO_2 = Liquid oxygen.
NA = Not applicable.
N_2H_4 = Anhydrous hydrazine.
NH_4ClO_4 = Ammonium perchlorate.
PPF = Payload Processing Facility.
RCS = Reaction control system.
SRM = Solid rocket motor.

motor 60) is derived from its diameter (60 inches) and its motor case material (graphite epoxy). The case material would be the same as that used for the SRMs analyzed in the 1998 FEIS, with the exception of a fiberglass overwrap on the forward and aft ends of the case used to prevent damage during the machining process. These new SRMs would use the same solid-propellant formulation analyzed in the 1998 FEIS, which consists of NH_4ClO_4, powdered Al, and HTPB. Each motor would contain approximately 65,520 pounds of propellant.

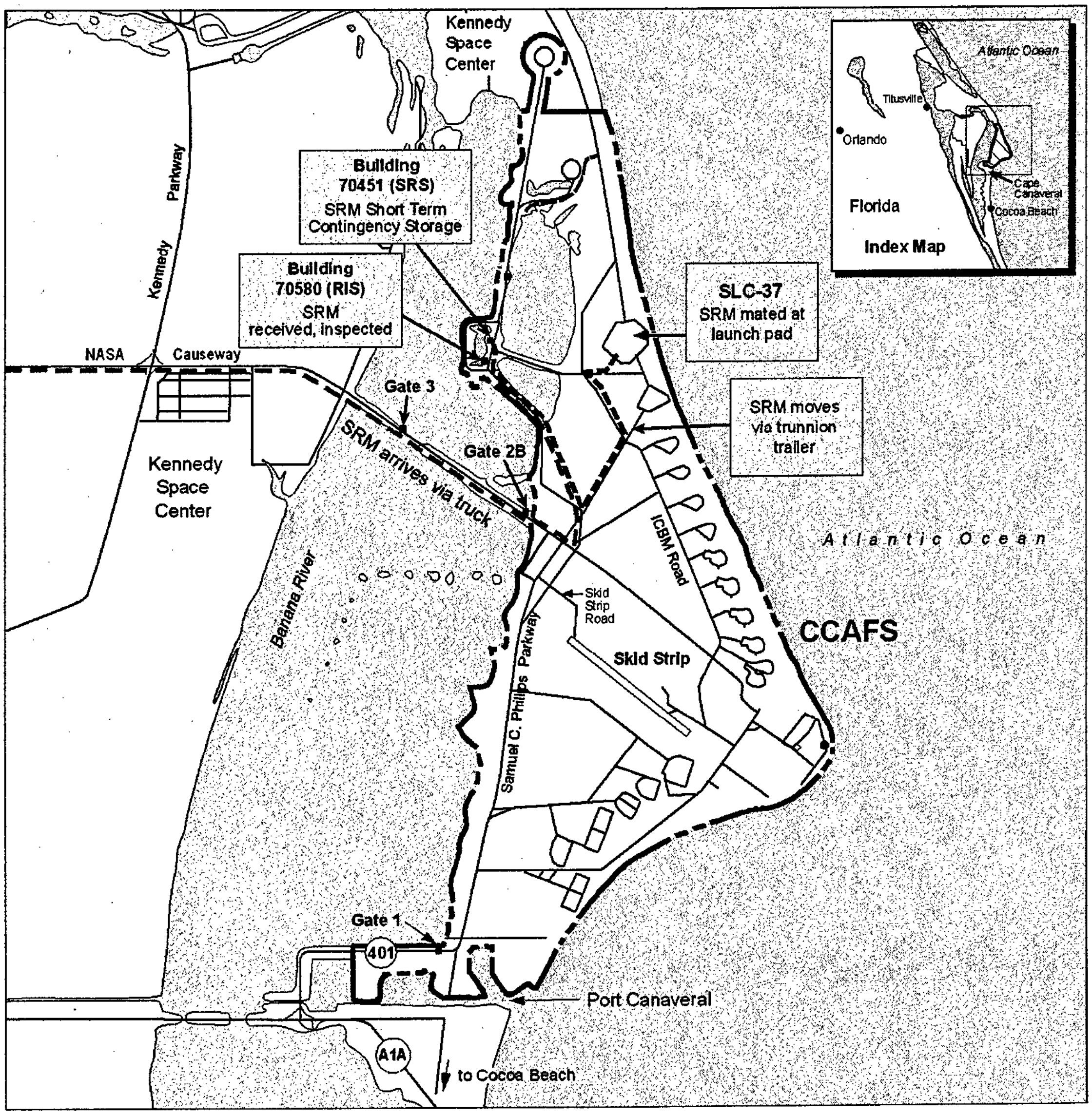
2.1.3.2.2 Primary Support Facilities

Various facilities and equipment are necessary to process and launch the Delta IV family of launch vehicles. Most of these were analyzed in the 1998 FEIS and the ROD allowed for their implementation. This document identifies the additional facility requirements for the use of larger SRMs at both launch sites.

A comprehensive list of primary support facilities used by the Delta IV M+ at CCAFS is shown on Table 2.1-8. This table includes all facilities at CCAFS that would be used for Delta IV operations, including those proposed for use in support of SRMs. The route that would be used to deliver SRMs to CCAFS is shown in Figure 2.1-11, including the route the SRM transport vehicles would follow to SLC-37.

Figure 2.1-12 illustrates the launch pad. The delivery route and launch pad would be the same as for the No-Action Alternative.

A comprehensive list of primary support facilities used by the Delta IV M+ at Vandenberg AFB is shown on Table 2.1-9. This table includes all facilities at Vandenberg AFB that would be used for Delta IV operations, including those proposed for use in support of SRMs.



EXPLANATION

SRM = Solid Rocket Motor
RIS = Receipt Inspection Shop
SRS = Segment Ready Storage

Station Boundary
A1A State Route
SRM Route (truck)
SRM Route (trunnion trailer)

0 3000 6000 12000 Feet

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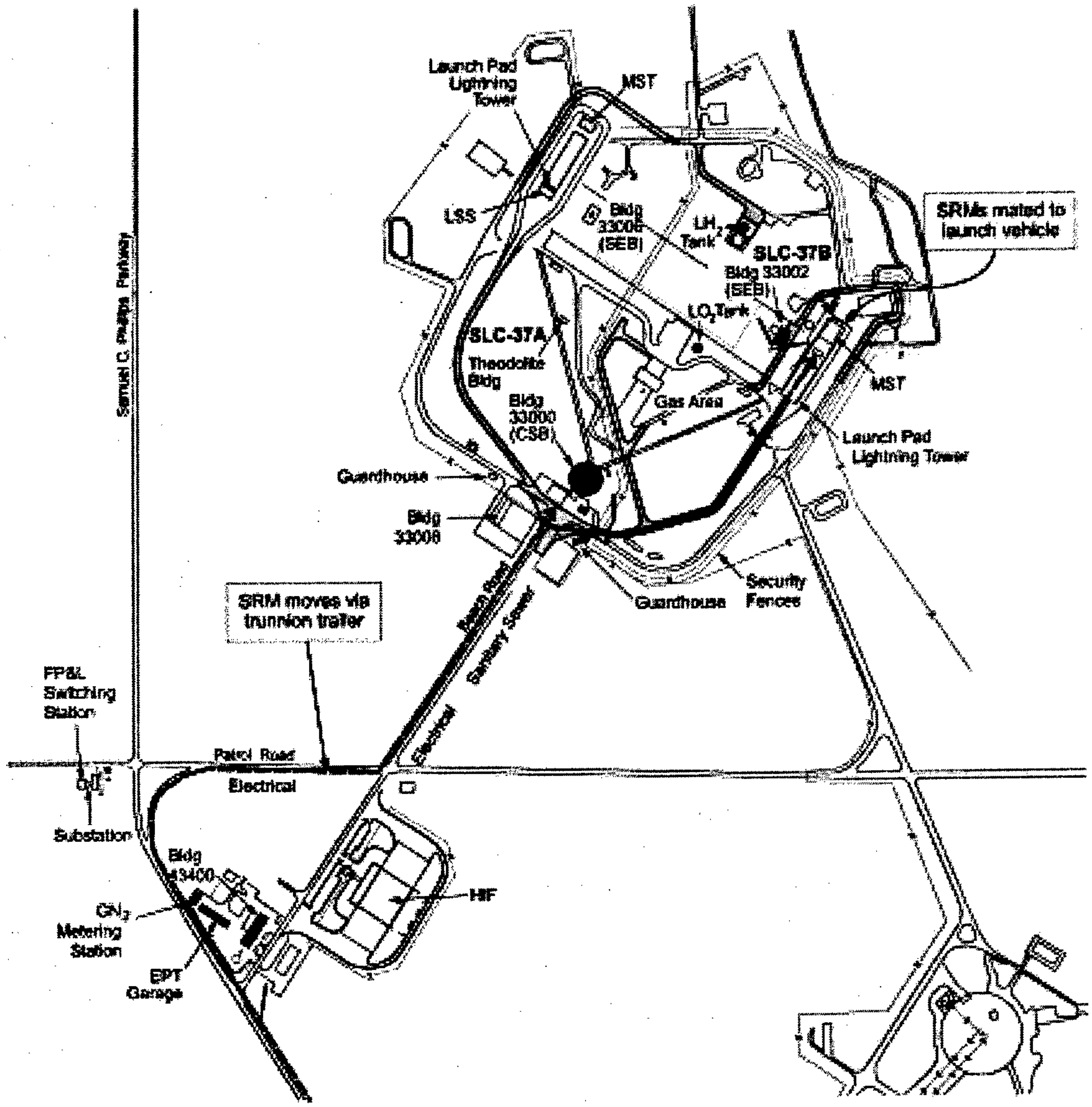
Delta IV M+ Transport Route CCAFS, Florida

Figure 2.1-11



EXPLANATION

CSB	= Common Support Building	LH_2	= Liquid Hydrogen
EPT	= Elevated Platform Transporter	LO_2	= Liquid Oxygen
FP&L	= Florida Power and Light	MST	= Mobile Service Tower
GN_2	= Gaseous Nitrogen	SEB	= Support Equipment Building
HIF	= Horizontal Integration Facility	SRM	= Solid Rocket Motor
		▬	SRM Route (trunnion trailer)

0 400 800 Feet

Delta IV M+ SLC-37 Site Plan and Flow CCAFS, Florida

Figure 2.1-12

TABLE 2.1-8
Primary Support Facilities, Cape Canaveral Air Force Station, Delta IV System

Common Support Facility	Building
Barge/Boat Unloading[a]	Port of Canaveral Dock
Receipt Inspection Shop[b]	**Building 70580**
Segment Ready Storage[b]	**Building 70451**
Aircraft Unloading[a]	CCAFS Skid Strip
Storage Facility[a]	Building 1348 (Hangar C)
Equipment Storage Facility[a]	Buildings 33008/43400
Electric Substation[a]	New Construction
Machine Shop[a]	Building 43400
Storage/Office Space[a]	Buildings 38804/38835 (CPF Complex) (now called DOC)
Horizontal Integration Facility[a]	New Construction
DSCS Processing Facility[a]	Building 55820 (DSCS Processing Facility)
Payload Processing Facility[a]	Building 70000 (SPIF)
Launch Complex[a]	SLC-37 (Pads 37A and 37B)
Launch Control Center[a]	Building 38835 (CPB) (now called DOC)

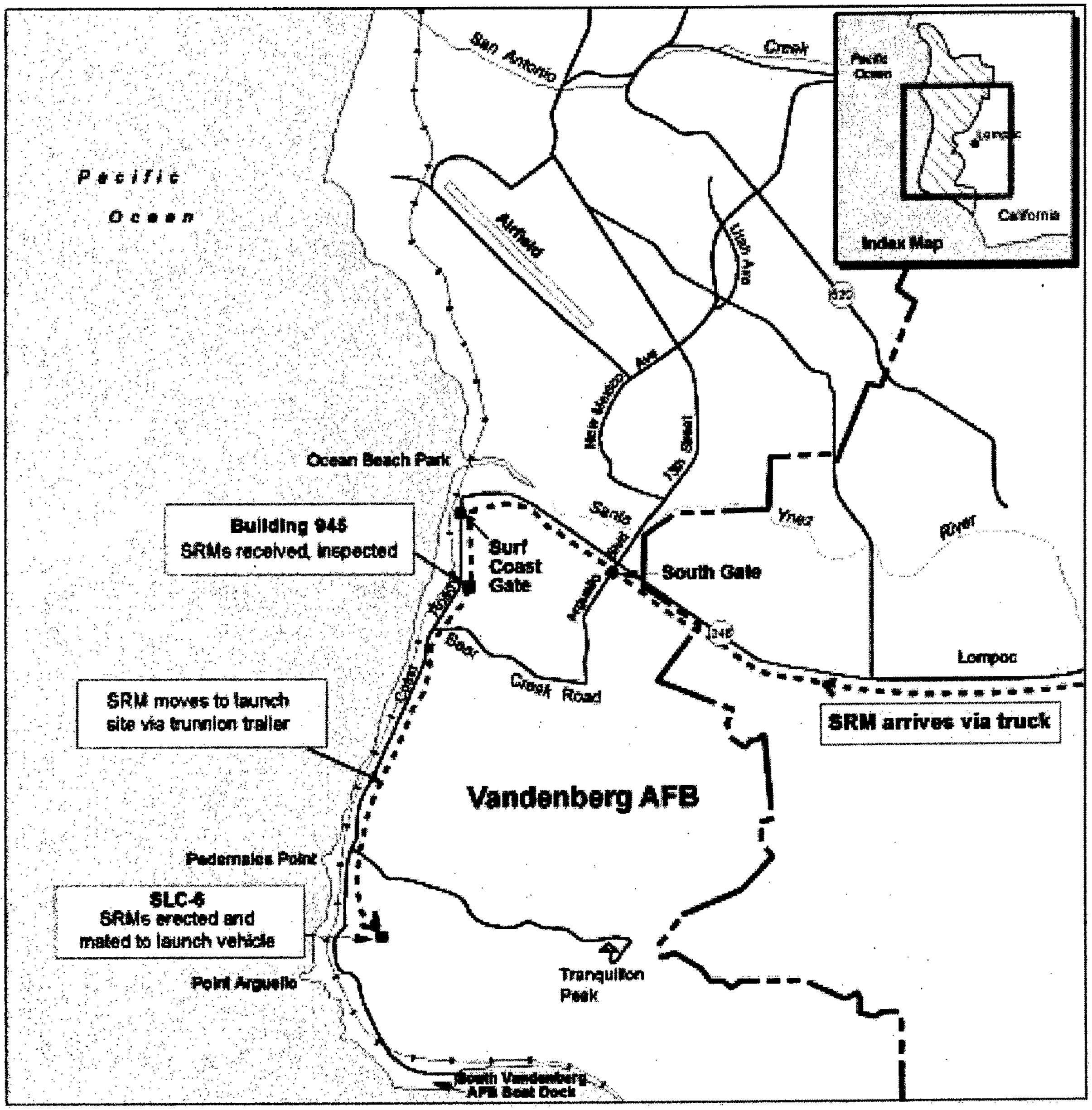
[a]Support facility addressed in the 1998 FEIS.
[b]Support facility not addressed in the 1998 FEIS but will be used for both the Proposed Action and the No-Action Alternative in this FSEIS. Minor paving around the RIS may be required. Minor interior modifications will also be necessary.

CCAFS = Cape Canaveral Air Force Station.
CPF = Centaur Processing Facility.
DOC = Delta IV Operations Center.
DSCS = Defense Satellite Communications Systems.
SLC = Space Launch Complex.
SPIF = Spacecraft Processing Integration Facility.

The route that would be used to deliver SRMs to Vandenberg AFB is shown in Figure 2.1-13, including the route the SRM transport vehicles would follow to SLC-6. Figure 2.1-14 illustrates the launch pad. The delivery route and launch pad would be the same as for the No-Action Alternative.

Unloading Facilities. For Delta IV launches, the SRMs would be delivered via truck from the manufacturer (Alliant Techsystems Corporation in Magna, Utah) to the Receipt Inspection Shop (RIS) Building 70580 at CCAFS and to Building 945 at Vandenberg AFB. The SRMs would then be unloaded and tested prior to loading onto traveling-trunnion trailers for transportation. Currently, the contractor plans to drive the loaded trucks into the respective RIS facilities at the launch sites and remove the top of the trailer with a bridge crane. The SRMs would then be offloaded, using the bridge crane, onto a dolly or chock.

Pavement would be added in certain areas near the RIS to enable the trucks to access the facility (see Figure 2.1-15). This additional paving for a vehicle turnaround area was not assessed in the 1998 FEIS.



EXPLANATION

Base Boundary

(246) State Route

SRM Route

SLC = Space Launch Complex

SRM = Solid Rocket Motor

0 .5 1 2 Miles

Delta IV M+ Transport Route Vandenberg AFB, California

Figure 2.1-13

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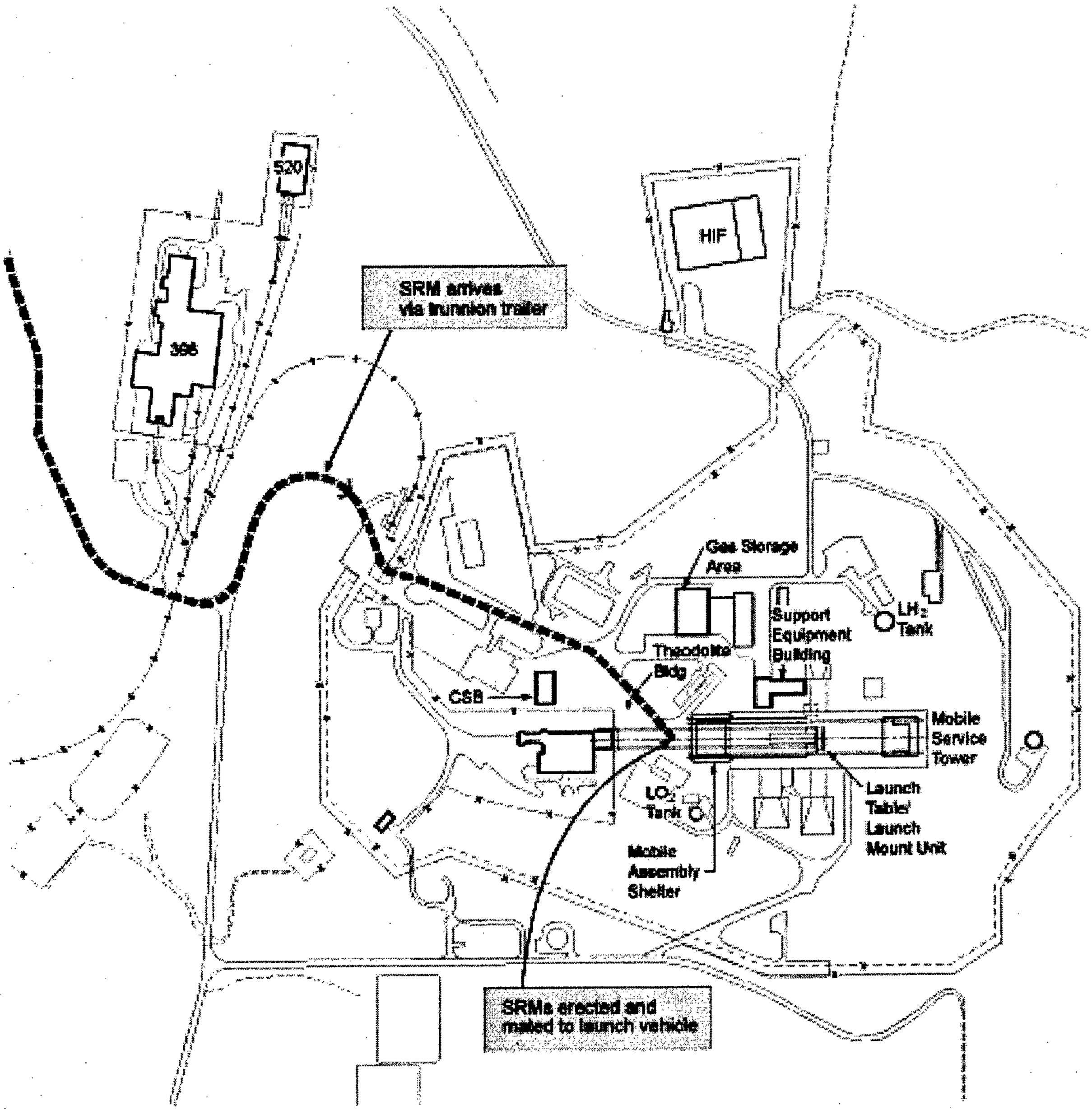

EXPLANATION

CSB = Common Support Building
HIF = Horizontal Integration Facility
LH_2 = Liquid Hydrogen
LO_2 = Liquid Oxygen
SRM = Solid Rocket Motor

SRM Route (trunnion trailer)
Security Fence
Double fence (if required)

0 200 400 800 Feet

Delta IV M+ SLC-6 Site Plan and Flow Vandenberg AFB, California

Figure 2.1-14

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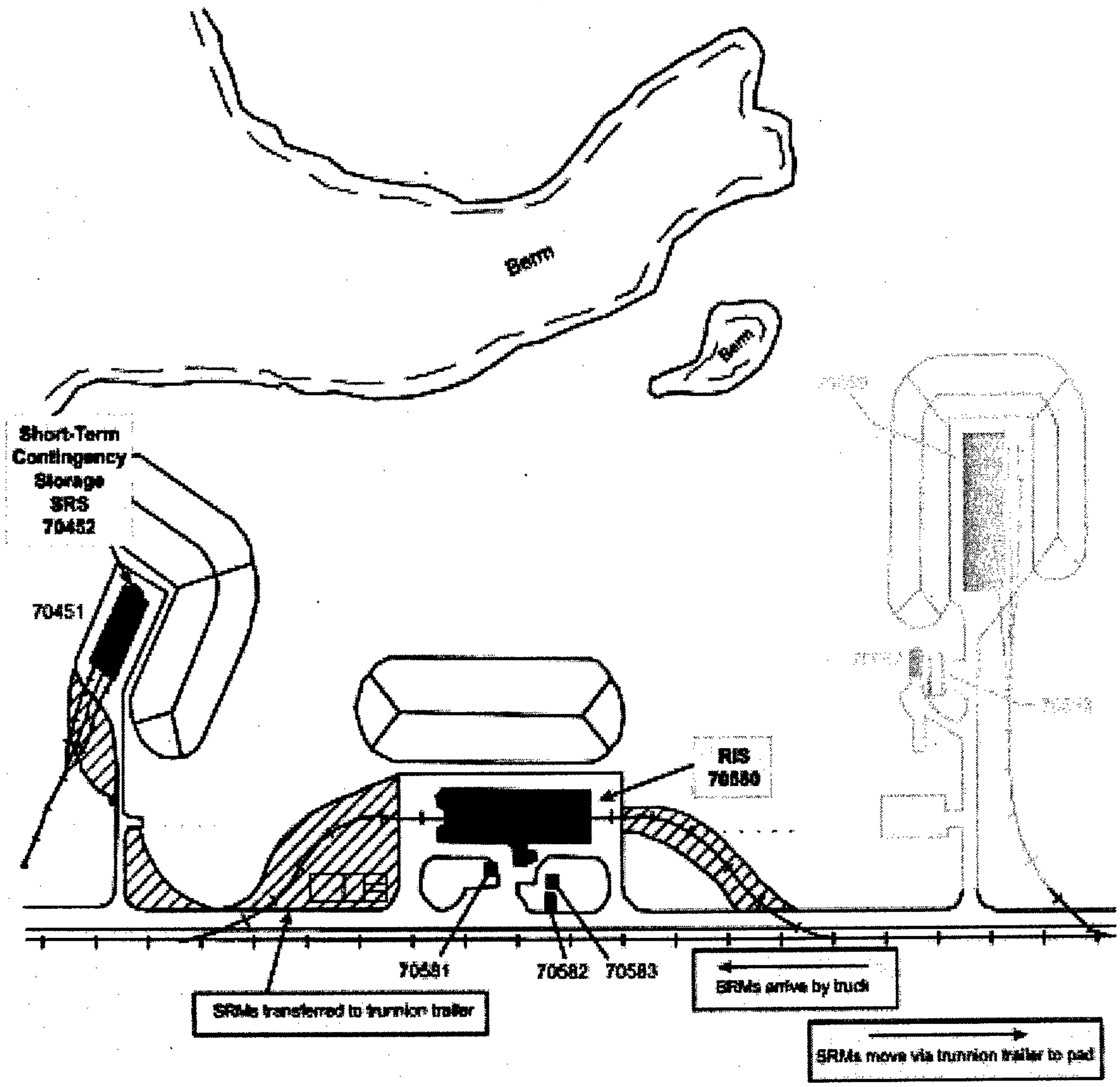

SRM = Solid Rocket Motor

RIS = Receiving, Inspection, Storage

SRS = Segment-Ready Storage

Potential Paving Areas

Delta IV M+
Potential New Pavement Area to Accommodate Larger SRMs, CCAFS, Florida

Not to Scale

Figure 2.1-15

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TABLE 2.1-9
Primary Support Facilities, Vandenberg AFB, Delta IV System

Common Support Facility	Building
Barge/Boat Unloading[a]	South Vandenberg AFB Boat Dock
Aircraft Unloading[a]	Vandenberg AFB Airfield
Storage and Refurbishment[a]	Buildings 330, 398, 520
Horizontal Integration Facility[a]	New Construction (SLC-6)
Payload Processing Facilities[a]	Building 375 (IPF) Building 1032 (Astrotech) New Construction (SLC-6)
SRM Staging and Processing[b]	**Building 945**
Launch Complex[a]	SLC-6
Launch Control Center[a]	Building 8510 (RLCC)

[a]Support facility addressed in the 1998 FEIS.
[b]Support facility not addressed in the 1998 FEIS, but will be used for both Proposed Action and the No-Action Alternative in this FSEIS. Only minor interior modifications will be necessary.

EELV = Evolved Expendable Launch Vehicle.
IPF = Integrated Processing Facility.
RLCC = Remote Launch Control Center.
SLC = Space Launch Complex.
SRM = Solid rocket motor.

Staging/Storage Facilities. Launch processing of the Delta IV M+ depends on a just-in-time delivery concept. If a launch is delayed for more than a short period of time, the SRMs could be returned to the manufacturing facility. For short delays, the SRMs would be kept in their containers and parked at a storage location where they would remain in the transport vehicles for the duration of the delay. These actions remain the same as the No-Action Alternative.

Building 70580, the existing RIS facility, would be used to transfer SRMs to traveling-trunnion trailers and for staging prior to launch. The RIS would be sized to accommodate three vehicle-sets of SRMs (for approximately 12 SRMs onsite at any one time). Both the RIS and Building 70451, the Segment Ready Storage (SRS) facility, would require the removal of an existing railroad track and/or paving an area leading into the buildings to accommodate the larger SRMs. Interior building modifications would be needed for both buildings to accommodate SRMs for both the Proposed Action and the No-Action Alternatives. The SRS would be the short-term contingency storage area for SRMs if launches at SLC-37 were delayed up to 6 months. The use of this facility would be the same for both the Proposed Action and the No-Action Alternatives. Because the RIS and SRS would be used to receive and stage the SRMs, Area 57 (Buildings 50801 and 50803) described in the 1998 FEIS is deleted from this Proposed Action.

At Vandenberg AFB, some of the ancillary facilities at SLC-6 are currently being used by Space Systems International (SSI) for commercial launch purposes. Building 945 would be used for processing and launch of the Delta IV vehicles with larger SRMs. The interior of the

building would require minor modifications to accommodate the larger SRMs, which may include a bridge crane to transfer SRMs to the traveling trunnion trailers. Interior modifications of this building could be required to accommodate SRMs for both the Proposed Action and the No-Action Alternative. In the interim, since the DSEIS was released, road and infrastructure modifications are being considered in the vicinity of Building 945. Potential impacts associated with these changes will be addressed in a separate NEPA review process. Building 945 would be used as the staging area for SRMs if launches at SLC-6 were delayed 1 to 2 weeks. A maximum of four SRMs would be stored in Building 945 at any one time. The use of this facility would be the same as for the No-Action Alternative. Because the SRMs would be staged and processed in Building 945, Building 1670 (described in the 1998 FEIS) is deleted from this Proposed Action.

Assembly Facilities (Horizontal Integration Facilities). No changes to the existing assembly facilities would be required at either Delta IV launch site to accommodate larger SRMs associated with the Proposed Action. The SRMs would be attached to the common booster core on the launch pad in the Mobile Service Tower. Following assembly, the common booster core propellant would be loaded, final checkout completed, and launch sequence initiated. The attachment of the SRMs would be essentially identical to the No-Action Alternative, with slightly larger attachment hardware and handling equipment.

2.1.3.2.3 Launch Site Operations

Launch-site operations for the Delta IV system were outlined in the 1998 FEIS (see Figure 2.1-10). Launch operations involving the use of the larger SRMs are outlined below.

Component Receipt and Checkout. The larger SRMs would be transported directly from the manufacturer in Magna, Utah, to the launch site. The motors would be transported via an extra-long trailer, with each vehicle carrying a single motor. The extra-long trailers would follow DOT-approved routes, the same routes as previously planned for the smaller SRMs, and would adhere to all applicable federal and state highway transportation safety measures. There would be no change in this process from that previously analyzed in the 1998 FEIS, which was allowed for implementation by the ROD.

For delivery to CCAFS, the SRMs would enter through Gate 3 on the NASA Causeway, then over Air Force-controlled secondary roadways, Samuel C. Phillips Parkway to Titan III Road, to the RIS (Figure 2.1-11).

Delivery to Vandenberg AFB would be via the Surf Coast Gate entrance off SR-246, then over Coast Road, an Air Force-controlled secondary roadway, to Building 945 (Figure 2.1-13).

After delivery, the SRMs would be inspected to verify that no out-of-specification conditions were created as a result of transportation to the site. These activities would be identical to those under the No-Action Alternative.

The manufacturer would perform NDE of the SRMs at its own facility prior to shipment. NDE could include x-ray and/or ultrasound analysis and would be performed to ensure that no irregularities exist in the SRM. Boeing would also perform limited NDE at both CCAFS and Vandenberg AFB for the first few launch vehicles to verify that transport does not jeopardize the integrity of the SRMs. Boeing would use existing facilities and no new construction would be required.

Launch Vehicle Integration. There would be no change in launch vehicle integration from the No-Action Alternative.

Launch Sequence. The SRMs would be ignited shortly after the core booster is fired. All SRMs would be ignited simultaneously. Following liftoff, the SRMs would continue to burn until the propellant is depleted after approximately 95 seconds. Following burnout, the motor cases would stay attached to the common booster core for an additional 4 seconds at Vandenberg AFB to clear the Channel Islands no-impact zone; they would then separate from the booster and fall into the ocean. The expended motor cases and nozzles would not be recovered.

Post-Launch Activities. As a result of the larger SRMs, the composition of launch pad washdown water used following the launch would change from the No-Action Alternative. The water would contain more HCl and Al_2O_3 from the SRM exhaust. This change in water composition is addressed in the Water Quality section of this document (Section 4.9). A maximum of 60,000 gallons of washdown water would be used per post-launch. This amount is an increase from the 1998 FEIS, which stated that only 30,000 gallons would be used per post-launch. This additional water use would occur with or without the Proposed Action. Additional post-launch activities from the employment of larger SRMs on the Delta IV systems would be the same as in the No-Action Alternative.

2.2 No-Action Alternative to the Proposed Action

The No-Action Alternative for this FSEIS is essentially the same as Concept A/B of the Proposed Action, which was analyzed in Section 2.1.3 of the 1998 FEIS. The ROD for the 1998 FEIS allowed the continued development and deployment of Concept A/B; in effect, this means that both Boeing and LMC would be allowed to continue to develop and deploy their respective EELV systems. At the time of publication of this FSEIS, both launch contractors are implementing their EELV launch systems on both coasts, in accordance with the 1998 FEIS analyses and the determination in the ROD.

Subsequent to the preparation of the 1998 FEIS, however, launch projections over the 20-year planning period using the vehicle configurations considered in that document changed as a result of updates in the Air Force Space Command's NMM (the long-range launch planning document for all government missions) and the Department of Commerce COMSTAC's Launch Forecast (the long-range planning document for all commercial space launch missions). In addition, changes in system configurations offered by both launch contractors were also a factor considered in the forecast used in the FSEIS. While the total launches projected for Concept A/B in the FEIS totaled approximately 534 over the 20-year period, the projection for the No-Action Alternative in this FSEIS is now approximately 472 (see Table 2.1.3-2). The launch contractors will continue to use SLC-41 and SLC-37 at CCAFS, and SLC-3W and SLC-6 at Vandenberg AFB, as well as other support facilities at both locations, in support of the existing EELV program activities.

In addition to the change in projected launch rate, some other changes to the existing EELV program systems have occurred since the 1998 FEIS was completed. In summary, the changes to the 1998 FEIS that are included as part of the No-Action Alternative in this FSEIS are:

- Increased water usage for Atlas V launches
- Minor modifications to existing facilities and increased paved area for vehicle turnaround at the Receipt Inspection Shop and Segment Ready Storage at CCAFS
- Deletion of certain launch vehicle configurations

These changes are described in the sections below.

2.2.1 Launch Vehicle Concepts

2.2.1.1 Atlas V System

The LMC portion of Concept A/B included four launch vehicles: two MLVs and two HLVs. The four vehicles all used a Common Core Booster™ (CCB) as the main vehicle with rocket propellant-1 (RP-1) and liquid oxygen (LO_2) as propellants. The MLV models use a single CCB, and the HLV models use three CCBs strapped together. The upper stages were either a CUS with liquid hydrogen (LH_2) and LO_2 as propellants, or a Storable Upper Stage (SUS) with monomethyl hydrazine (MMH) and nitrogen tetroxide (N_2O_4) as propellants. Figure 2.1-1 illustrates the SRM-augmented Atlas V system vehicles proposed in this FSEIS, as well as the remaining Atlas V launch vehicles addressed under the No-Action Alternative.

Under the No-Action Alternative, no SRMs will be used with the Atlas V system. At this time, LMC does not foresee the use of vehicles using a SUS. Therefore, it is likely that no MMH propellant and no N_2O_4 oxidizer will be used.

2.2.1.2 Delta IV System

Under the No-Action Alternative, smaller SRMs than those of the Proposed Action will be used for the Delta IV system. The size, weight, and other characteristics of these smaller SRMs are described in Section 2.1.2 of the 1998 FEIS. The Star 48B SRM third stage and the Hypergolic Upper Stage (HUS) are not anticipated to be used at this time. As a result, Aerozine-50 and N_2O_4 (to fuel the HUS) are not included as elements of either the No-Action Alternative or the Proposed Action. If a determination is subsequently made to use the Star 48B SRM Third Stage or the HUS for further missions, the impacts associated with these have been previously addressed in the 1998 FEIS.

2.2.2 Launch Site Operations

Launch vehicle components will be delivered to the sites as described in the 1998 FEIS (Section 2.1.1.3 for the Atlas V system and Section 2.1.2.3 for the Delta IV system). Under the No-Action Alternative, launch operations will be conducted as described in the 1998 FEIS. A few additional changes have been identified since the 1998 FEIS was completed, and are described below.

Quantities of hazardous materials to be used for the No-Action Alternative will be the same per launch as shown in the 1998 FEIS (see 1998 FEIS, Table 2.1-2 for the Atlas V system and Table 2.1-6 for the Delta IV system).

2.2.2.1 Atlas V System

The types and quantities of propellants listed in the 1998 FEIS, Table 2.1-1, for the Atlas V system will be reduced because MMH and N_2O_4 will no longer be needed for the SUSs. The small amounts of hydrazine listed under the Reaction Control System heading on that table will also not be needed. The operations associated with the use of the SUS will no longer be included in the pre-launch procedures.

An update to the quantity of water to be used with the Atlas V system launches has been identified since the 1998 FEIS was prepared, as explained in Section 2.1.3.1.3.

2.2.2.2 Delta IV System

In the interim between the 1998 FEIS and the FSEIS, the quantities of propellants for the Delta IV system have been reduced, and operations associated with launching DIV-S versions will be replaced with DIV M or M+ operations at the East and West Ranges (EWRs) (see Section 2.2.1.2, above).

2.2.3 Safety Systems

The No-Action Alternative will be constructed and operated in accordance with the same safety rules and policies described in the 1998 FEIS (Section 2.1.1.4 for the Atlas V system and Section 2.1.2.4 for the Delta IV system).

2.2.4 Facilities

Construction activities described in the 1998 FEIS (Section 2.1.1.10 for the Atlas V system and Section 2.1.2.10 for the Delta IV system) will still occur under the No-Action Alternative. Internal building modifications and changes in building use that differ from those described in the 1998 FEIS could occur before the EELV program is fully operational. If these changes are anticipated to cause any environmental impacts, they will be assessed in separate NEPA analysis, independent of this FSEIS. Some of these changes have been identified and are listed below.

2.2.4.1 Atlas V System

No changes in facilities from the 1998 FEIS that will involve ground disturbance are identified at this time. Some minor interior building modifications could occur.

2.2.4.2 Delta IV System

Changes in planned use of facilities since the 1998 FEIS are described below.

2.2.4.2.1 Vandenberg AFB

Building No. 522 near SLC-6 will be used for small ordnance storage.

Modifications will be made to the Vandenberg AFB boat dock, as well as strengthening and other minor modifications of the dock structure that will improve the delivery and transfer of the common booster core (CBC) to the launch site. These modifications are currently in

the design phase, but could include limited dredging near the dock, strengthening, and other minor modifications of the dock structure.

The mobile propellant handling systems for A-50 propellants and N_2O_4, described in the 1998 FEIS, will no longer be used.

The launch contractor has determined that CBC staging needs to take place on an open, concrete pad located adjacent to the road leading to the Vandenberg AFB Dock. This open, paved apron is 450 feet by 60 feet, and will require four new light standards positioned on the north side of the apron. Because of construction and functional requirements, one existing power pole will be removed. This work will require additional construction personnel, grading, concrete trucks, and electrical modifications. The modifications will involve minimal changes to the existing site landscape, which is already disturbed.

2.2.4.2.2 Cape Canaveral Air Force Station

Hangar E will be modified to accommodate administrative and support functions. This modification will require additional personnel support/functional areas, such as automobile parking, toilet facilities, and heating/ventilation/air conditioning (HVAC) equipment to make the facility habitable for the staff.

The mobile propellant handling systems for MMH and N_2O_4, as described in the 1998 FEIS, will no longer be used.

2.3 Alternatives Eliminated from Further Consideration

Refer to the 1998 FEIS for information about alternatives eliminated from further consideration.

2.4 Other Future Actions and Potential for Cumulative Impacts

This section identifies other current and future projects and actions that, in conjunction with the Proposed Action, have the potential to result in cumulative impacts to the environment. Launch programs other than the EELV program are discussed first, followed by a discussion of other launch activities and other actions in the vicinity of CCAFS and Vandenberg AFB.

2.4.1 Other Space Launch Programs

Because of a strong demand for launching capacity, a profitable market, and existing technological capability, future launching of payloads is projected to increase over the next 10 years (FAA, 1999). Numerous launch programs will be under way during the period of the Proposed Action, including those described on Table 2.4-1.

2.4.1.1 Global Space Launch Projections

If the Proposed Action were not implemented, foreign launch vehicles would likely provide the launch capacity needed to meet commercial demand. Because these other launch vehicles and programs are available, the total number of global launches is likely to remain the same, with or without the Proposed Action. Therefore, when measured in terms of the total number of launches, the cumulative effect of the Proposed Action and other global launches would be approximately the same as the total effect without the Proposed Action.

TABLE 2.4-1
Annual Solid Rocket Motor Launches During Period 1989 to 1998

Country	Rocket	Number of Launches									
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Brazil											
	VLS	-	-	-	-	-	-	-	-	1	-
France											
	Ariane 2/3	3	-	-	-	-	-	-	-	-	-
	Ariane 42P	-	1	-	3	1	2	1	2	-	1
	Ariane 44LP	2	1	1	1	2	3	2	1	2	2
	Ariane 44P	-	-	2	-	-	-	2	2	4	-
	Ariane 5	-	-	-	-	-	-	-	1	1	1
India											
	ASLV	-	-	-	1	-	1	-	-	-	-
	PSLV	-	-	-	-	1	1	-	1	1	-
Israel											
	Shavit	-	1	-	-	-	1	1	-	-	1
Japan											
	H-1	1	2	1	1	-	-	-	-	-	-
	H-2	-	-	-	-	-	2	1	1	1	1
	Mu-3S	1	1	1	-	1	-	1	-	-	-
	MV	-	-	-	-	-	-	-	-	1	1
Russia											
	Start	-	-	-	-	-	-	1	-	-	-
	Start-1	-	-	-	-	1	-	-	-	2	-
United States											
	Athena-I	-	-	-	-	-	-	1	-	1	-
	Athena-II	-	-	-	-	-	-	-	-	-	1
	Atlas IIAS	-	-	-	-	1	1	4	1	5	2
	Conestoga	-	-	-	-	-	-	1	-	-	-
	Delta III	-	-	-	-	-	-	-	-	-	1
	Delta 3925	1	-	-	-	-	-	-	-	-	-
	Delta 4920	1	1	-	-	-	-	-	-	-	-
	Delta 5920	1	-	-	-	-	-	-	-	-	-
	Delta 6925	5	9	1	2	-	-	-	-	-	-
	Delta 7925	-	1	4	9	7	3	3	10	11	12
	Scout G	-	1	1	2	1	1	-	-	-	-
	Shuttle	5	6	6	8	7	7	7	7	8	5
	Taurus	-	-	-	-	-	1	-	-	-	2
	Titan IV	1	2	2	1	1	4	4	4	2	1
	Titan IVB	-	-	-	-	-	-	-	-	2	1
	Titan 34D	2	2	-	1	-	-	-	-	-	-
Yearly Totals		**23**	**28**	**19**	**29**	**23**	**27**	**29**	**30**	**42**	**32**

Yearly Average Number of Solid Rocket Motor Launches 1989-1998: 28

Source: International Reference Guide to Space Launch Systems, and worldwide websites.

Global space launch projection data have been gathered from various sources, including NASA, the Air Force, and the COMSTAC 1999 Commercial Geostationary Orbit (GSO) Mission Model. The approximate number of total global commercial launches estimated from these sources is 51 commercial launches per year (FAA, 1999). The total number of global launches has been approximately 90 to 100 per year (FAA, 1999) and is expected, on average, to remain at this level over the period of the Proposed Action. This value potentially includes most major commercial and major government-sponsored launches, but might not account for many small commercial, military, weather, and other minor program launches. Improvements in technology and reductions in cost have the potential to result in a substantive increase in this number over the next 20 years. Conversely, a reduction in market demand, increased use of reusable vehicles that use runways instead of launch facilities, and other financial, technological, and political factors could reduce this number over time. In summary, the total number of global launches is expected to be approximately four to five times the number of launches of MLVs with SRMs that are associated with the Proposed Action.

2.4.1.2 Global Space Launches Involving SRMs

Several current U.S. and foreign space launch vehicles use SRMs. These are shown in Table 2.4-2.

TABLE 2.4-2
U.S. and Foreign Space Launch Vehicles Using SRMs

Country	Launch Vehicle	No. of SRM	Propellant Weight/SRM	Total Propellant Weight
United States	Space Shuttle	2	1,107,000 lbs	2,214,000 lbs
	Titan IVB	2	696,000 lbs	1,392,000 lbs
	Atlas IIAS	4	22,300 lbs	89,200 lbs
	Delta II	9	26,000 lbs	234,000 lbs
	Delta III	9	37,300 lbs	335,700 lbs
	Athena II	1	236,000 lbs	236,000 lbs
France	Ariane-5	2	583,000 lbs	1,166,000 lbs
China	Long March CZ-1D	2	1,930 lbs	3,860 lbs

The number of future launches of each vehicle that may use SRMs is unknown and cannot be reliably forecast. It is reasonable to assume, however, that the total use of SRMs would be approximately the same, with or without the Proposed Action, because payloads not carried by the Proposed Action could be carried on similar vehicles offered by other countries. It is also reasonable to assume that in the long term, near the end of the useful life of the EELV program, the global use of SRMs would diminish if new, lower-cost technology that does not use SRMs is introduced to satisfy the demand for payload launches.

2.4.2 Future Space Launch Programs at CCAFS and Vandenberg AFB

This section identifies future launch programs at CCAFS and Vandenberg AFB that have been projected and scheduled over the next 10 years.

2.4.2.1 Cape Canaveral Air Force Station

Future actions at CCAFS will include up to eight space shuttle launches per year until the year 2012. A number of domestic government launches of small rockets for military payloads will also occur annually. It is assumed that most of the future demand for commercial launches will be satisfied by EELV program launches at CCAFS. The EELV program will replace government launches of Titan, Atlas, and Delta launch vehicles that currently occur at this location.

2.4.2.2 Vandenberg AFB

Future actions at Vandenberg AFB will include the launching of several small rockets for military payloads, as well as some commercial launches each year. No space shuttle missions are launched from Vandenberg AFB. The EELV program will replace Air Force launches of existing Titan, Atlas, and Delta launch programs at Vandenberg AFB.

The California Commercial Spaceport, Inc., (CCSI) proposed to launch up to 24 payloads per year into polar orbit from Vandenberg AFB. The initial launch was proposed for 1996 and was planned to increase to a sustained rate of 24 launches per year by 1999 to 2000. The launches could continue for a period of up to 4 years. The majority of the rocket motors would be solid fueled, although one variant would have liquid-fueled rocket motors. An environmental assessment was prepared to identify the site of the Spaceport Launch facility (CCSI and Lockheed Systems and Technology Company 1994). As of the publication of this FSEIS, however, only one California Spaceport Authority (CSA) launch has occurred (the Minotaur/JAWSAT). Two other launches are tentatively planned (one each in 2000 and 2002). On the basis of communications with 30th SW's Range Operations Squadron and the Civil Engineering Squadron (Environmental Engineering Flight) and Spaceport Systems International, no other CSA launches are foreseeable.

On the basis of current projections for CSA launches, significant cumulative impacts would not occur as a result of the combined activities of the EELV program and the CSA launches. The Biological Opinion (BO) for the California Spaceport identifies detailed monitoring requirements and other measures to offset anticipated or potential impacts to plant and wildlife species. The BO requires a draft report on monitoring activities at the Spaceport to be submitted annually during periods that launch activities occur. The draft report is required to be approved by appropriate agencies before public release. Specific monitoring is to be conducted for peregrine falcons (which were recently delisted by the U.S. Fish and Wildlife Service), noise levels near brown pelican roost sites, and sea otter counts following launches. Water quality and species sampling will be conducted if predictive modeling indicates impacts from Spaceport launches. These reporting and monitoring activities are expected to result in avoidance of impacts that could be considered cumulatively significant in combination with the Proposed Action in this FSEIS.

2.4.3 Other Actions in the Vicinity of CCAFS and Vandenberg AFB

This section summarizes the communications with local planning entities in Brevard County, Florida, and Santa Barbara County, California, to identify other planned actions in the vicinity of CCAFS and Vandenberg AFB. It is expected that all local agency-approved projects for development will be consistent with local area plans.

2.4.3.1 Cape Canaveral Air Force Station

The Brevard County Land Development Group and City of Cape Canaveral Building Department were contacted and informed about the Proposed Action. Although projects currently in the planning stages include hotels and residential developments in several areas, these planned actions are not anticipated to result in cumulative impacts.

2.4.3.2 Vandenberg AFB

The Santa Barbara County Public Works Department, Planning and Development Department, and the City of Lompoc Planning Department have been contacted and informed about the Proposed Action. Although projects currently in the planning stages in the City of Lompoc include new residential and new commercial development, these planned actions are not anticipated to result in cumulative impacts.

2.5 Comparison of Environmental Impacts

The potential environmental impacts associated with implementation of the Proposed Action and the No-Action Alternative at CCAFS and at Vandenberg AFB are summarized in Table ES-1. Each resource potentially affected by implementation of the Proposed Action and the No-Action Alternative is listed, and proposed mitigation measures, if applicable, are presented. Impacts to the environment are described in detail in Section 4.

3.0 Affected Environment

3.1 Introduction

This section describes the existing environment of CCAFS, Florida, and Vandenberg AFB, California, and their respective regions of influence (ROIs). This information serves as a baseline from which to identify and evaluate potential environmental impacts that could result from implementing the Proposed Action. The baseline conditions assumed for the purposes of this analysis are the existing conditions at CCAFS and Vandenberg AFB. These conditions include the Proposed Action of the 1998 FEIS. The two families of lift vehicles addressed in the 1998 FEIS are identified by their proper names in this FSEIS. "Concept A" is referred to as the Atlas V system and "Concept B" is referred to as the Delta IV system.

Although this FSEIS focuses on the biophysical environment, the following nonbiophysical elements (influencing factors) in the region and local communities are also addressed: local community, land use and aesthetics, transportation, and utilities. In addition, this section describes the storage, usage, disposal, and management of hazardous materials/wastes as well as pollution prevention and the Installation Restoration Program (IRP) status. This section contains a description of health and safety practices at each installation, and the pertinent natural resources of geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. Information on low-income and minority populations in the area used for the environmental justice analysis concludes the section.

The ROI to be evaluated for the two installations is defined for each resource area potentially affected by the Proposed Action and the No-Action Alternative. The ROI determines the geographical area to be addressed as the affected environment. Although the installation boundary constitutes the ROI limit for many resources, potential impacts associated with certain issues (e.g., noise, potential noise impacts to threatened and endangered species, air quality, utility systems, health and safety procedures, and water resources) transcend these limits. Within each resource discussion, separate ROIs for the Atlas V and the Delta IV systems are provided, where applicable.

In many instances, the affected environment for the Proposed Action has not changed substantively since the 1998 FEIS. This section presents only information that is new or has been updated subsequent to the 1998 FEIS. As a result, much of the data in the 1998 FEIS remains valid and is incorporated by reference into this FSEIS.

3.2 Community Setting

Community setting was described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. For information on community setting at CCAFS or at Vandenberg AFB, refer to the 1998 FEIS.

3.3 Land Use and Aesthetics

Land use and aesthetics were described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. For information on land use and aesthetics refer to the 1998 FEIS.

3.4 Transportation

The existing transportation network has not changed substantively since the preparation of the 1998 FEIS. For more information on transportation and traffic, refer to the 1998 FEIS.

3.5 Utilities

The utility systems addressed in this FSEIS include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity. The area of analysis consists of all or portions of the service areas of each utility provider that serves the project site, other installation facilities, and incorporated and unincorporated areas of the applicable county. Utility usage was determined from records of purveyors, historic consumption patterns, and systemwide average annual growth rates.

Aside from water supply, the existing utility network and usage patterns have not changed substantively since the preparation of the 1998 FEIS. During preparation of the 1998 FEIS, a maximum per-launch water usage of 59,000 gallons was estimated to be necessary for the Atlas V launches. These values were based on the requirements of similar launch vehicles. More definitive design data now indicate a maximum need for 600,000 gallons per launch, of which 300,000 gallons would be captured in the launch exhaust duct. This corrected amount of water usage would be required both for the No-Action Alternative, as well as the Proposed Action launches. For information on utilities, refer to the 1998 FEIS.

3.6 Hazardous Materials and Hazardous Waste Management

This section describes the environmental setting for hazardous materials and hazardous waste management. The content has been edited and revised from the 1998 FEIS; consequently, it has been reproduced in this FSEIS for clarification.

3.6.1 Cape Canaveral Air Force Station

The ROI for CCAFS includes primarily the areas around SLC-41 and SLC-37, but also includes any industrial and office sites to be used by the EELV program launch contractor.

3.6.1.1 Hazardous Materials Management

Numerous types of hazardous materials are used to support the various missions and general maintenance operations at CCAFS. Categories of hazardous materials used in support of current lift vehicle system activities include petroleum products, oils, lubricants (POL), volatile organic compounds (VOC), corrosives, refrigerants, adhesives, sealants, epoxies, and propellants. Example quantities from current programs are provided in Section 3.6 of the 1998 FEIS.

The LVCs have developed their own hazardous materials management plans for the EELV program. Under the provisions of CCAFS leases, EELV program contractors are responsible for implementing these plans. Recent agreements reached with EELV contractors place increased responsibility for hazardous materials and waste management on the LVCs.

3.6.1.2 Hazardous Waste Management

Hazardous waste management, including explosive ordnance disposal (EOD) at CCAFS is regulated under the Resource Conservation and Recovery Act (RCRA) (Title 40 Code of Federal Regulations [CFR] 260-280) and the Florida Administrative Code (FAC) 62-730. It is the responsibility of each contractor to manage and dispose of all hazardous waste generated from its operations in accordance with all local, state, and federal regulations.

All hazardous waste is labeled with the U.S. Environmental Protection Agency (EPA) identification number for each contractor, under which it is transported, treated, and disposed of. All individuals or organizations generating hazardous waste at CCAFS are responsible for administering all applicable regulations and plans regarding hazardous waste.

Individual contractors and organizations maintain their own hazardous waste satellite accumulation points (SAP) and 90-day hazardous waste accumulation areas, in accordance with applicable RCRA regulations. There is no limit to the volume of hazardous waste that can be stored at a 90-day hazardous waste accumulation area, but wastes must be taken to the permitted storage facility or disposed of offsite within 90 days.

The contractor is responsible for the collection and transport of hazardous wastes (including propellant waste) from the SAPs to a 90-day hazardous accumulation area, then to an offsite permitted treatment, storage, and disposal facility (TSDF). The contractor is responsible for ensuring that the management and disposal of all hazardous wastes would be conducted in accordance with all applicable federal, state, and local regulations. The CCAFS TSDF is not available for storage of any EELV program wastes.

The contractor will coordinate all environmental emergency response actions at the leased EELV premises.

3.6.1.3 Pollution Prevention

Contractors are responsible for developing and implementing their own Pollution Prevention Management Plans (PPMPs) to comply with all state, federal, and local regulations. As specified under lease agreements and contracts, the contractors are under contract to reduce, where possible, the use of Class II Ozone-Depleting Substance (ODS) and Environmental Planning and Community Right-to-Know Act (EPCRA) 313 chemicals. The only anticipated use for Class II ODSs is the use of refrigerants in the HVAC system of the EELV program buildings, as well as in spray-on foam insulation repairs to the launch vehicle. Class 1 ODSs will not be used in the EELV program, as defined by contract.

3.6.1.4 Installation Restoration Program

The IRP efforts at CCAFS have been conducted in parallel with the program at Patrick AFB, and in close coordination with EPA, the Florida Department of Environmental Protection (FDEP), and NASA. CCAFS is not a National Priorities List (NPL) site. The IRP sites are remediated under RCRA regulations in lieu of Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA). The government is undertaking IRP environmental response actions at the two CCAFS EELV program launch sites. This section provides an update to the 1998 FEIS. The following discussion focuses on EELV program activities at CCAFS that have the potential to affect the ongoing investigations of IRP and area of concern (AOC) sites.

3.6.1.4.1 Atlas V System

IRP Site DP-24 [Solid Waste Management Unit (SWMU) C047] is located at SLC-41. Hydrazine, diesel fuel, halogenated solvents, paints, thinners, trace metals, and waste oils may have been disposed of at this site from past Air Force operations. A RCRA Facility Investigation (RFI) has been conducted at this site.

In October 1996, an estimated 150,000 tons of polychlorinated biphenyl (PCB)-contaminated soils were identified at SLC-41. Approximately 25 percent of the contaminated soil was identified as containing PCB concentrations exceeding the Toxic Substances Control Act-regulated level of 50 ppm. The State of Florida regulates cleanup for industrial sites with contamination levels greater than 3 ppm. Removal of the contaminated soil was completed in August 1999 to a negotiated risk-based cleanup level of 18 ppm.

3.6.1.4.2 Delta IV System

IRP Site C-L37 (SWMU 56) is located at SLC-37. Hydrazine, diesel fuel, RP-1, hydrocarbons, PCBs, solvents, and waste oils may have been disposed of in several areas of this site. The site underwent an RFI under the IRP to determine whether the soil and groundwater at the site are contaminated. NASA investigated this site in accordance with a Memorandum of Agreement (MOA) with the 45 Space Wing (SW). PCBs have been identified in the surface soil at the site. Air Force Space Command (AFSPC) and NASA have determined the areas for which each agency will be responsible. The PCB-contaminated soil was remediated during 1998 and is expected to cause no further conflicts with launch program activities.

3.6.2 Vandenberg AFB

The ROI for Vandenberg AFB includes the areas around SLC-3W and SLC-6, and areas adjacent to current facility locations.

3.6.2.1 Hazardous Materials Management

Numerous types of hazardous materials are used to support the various missions and general maintenance operations at Vandenberg AFB. Categories of hazardous materials used during current lift vehicle system activities include lift vehicle and satellite fields, POLs, VOC, corrosives, refrigerants, adhesives, sealants, epoxies, and propellants. Example quantities from current programs are provided in the 1998 FEIS, Section 3.6. Vandenberg AFB requires all contractors using hazardous materials to submit a hazardous materials contingency plan prior to working on the base. Recent agreements reached with EELV contractors place increased responsibility for hazardous materials and waste management on the LVCs.

Spills of hazardous materials are covered under the Hazardous Materials Emergency Response Plan. This plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

3.6.2.2 Hazardous Waste Management

Hazardous wastes at Vandenberg AFB are regulated by RCRA (Title 40 CFR 260-280) and the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), under the California Health and Safety Code, Title 22, Division 20, Chapter 6.5, Sections 25100 through 25159, and the California Administrative Code, Sections 25100 through 67188. These regulations require that hazardous wastes be handled, stored, transported, disposed of, or recycled.

The lift vehicle contractors' Hazardous Waste Management Plan (HWMP) implements the regulations and outlines the procedures for disposing of hazardous waste. All hazardous waste generated is labeled with the EPA identification number for each contractor under which it is transported, treated, and disposed of. All individuals or organizations at Vandenberg AFB are responsible for administering all applicable regulations and plans regarding hazardous waste, and for complying with applicable regulations regarding the temporary accumulation of waste at the process site. The contractor is responsible for the maintenance of hazardous waste SAPs and 90-day storage areas, in accordance with local, state, and federal regulations.

3.6.2.3 Pollution Prevention

Under the current EELV launch service contracts, LMC and Boeing are responsible for developing and implementing their own PPMP to comply with all local, state, and federal regulations. As specified under lease agreements and under EELV contract requirements, the contractors have developed a HWMP to outline strategies to minimize the use of Class II ODSs and EPCRA 313 chemicals. No Class I ODSs will be used in the EELV program.

3.6.2.4 Installation Restoration Program

Vandenberg AFB is not listed on the NPL. The IRP sites at Vandenberg AFB are being addressed in a manner generally consistent with the CERCLA process.

This section provides an update to the 1998 FEIS IRP discussion for locations near the EELV program launch sites. This material is relevant to both the No-Action Alternative and the Proposed Action because construction schedules must be coordinated with IRP actions.

3.6.2.4.1 Atlas V System

IRP Site 6 (SLC-3W) is located at the northwestern end of Alden Road at SLC-3W. Hazardous substances that may have been released include RP-1 unsymmetrical dimethylhydrazine (UDMH), component flushing solvents [trichloroethylene (TCE), methylene chloride, and isopropyl alcohol], diesel fuel, waste oil, trace metals in deluge water, and paint residue in sandblast grit. In 1990, initial soil sampling was conducted at the site; followup sampling was conducted in 1992. Based on the sampling results, IRP Site 6 was recommended for no further response action planned (NFRAP) because all residual contaminants were found to be below levels that would pose an unacceptable risk to human health and the environment. Regulatory concurrence has been obtained on the NFRAP for IRP Site 6. Any future environmental response actions will be conducted under the environmental compliance programs, because construction activities analyzed in the 1998 FEIS could change exposure pathways.

IRP Site 7 (Bear Creek Pond) is located west of Old Surf Road, just south of Bear Creek Pond. The pond area is the farthest downgradient portion of Bear Creek prior to Coast

Road. At SLC-3E and SLC-3W, deluge water was released to Bear Creek Canyon. Contaminants of concern include hydrazine, solvents, lubricating oil, metals, and TCE. A Phase II remedial investigation (RI) Work Plan was completed for the site in 1996 to fill gaps identified in the Phase I data. Phase II RI field sampling and analyses have been conducted.

Two AOCs associated with the SLC-3W area were identified during the preliminary assessment/site investigation (SI). AOC-66 is located at Building 765, a missile/space research facility with a substation and a transformer with detectable levels of PCBs. AOC-91, a 55-gallon waste oil drum, was associated with the Water Pump House, Building 78. The drum has been removed under a compliance removal action.

Adjacent Facilities. Building 7525, the Booster Assembly Building (BAB), is associated with AOC-143. In the past, a mixture of TCE and water was released to grade. Currently, the building includes a paint spray booth, a hydraulic pumping station, and facilities for the use of solvents, photoprocessing chemicals, and freon.

3.6.2.4.2 Delta IV System

There are no IRP sites located at SLC-6. AOC-89, however, is associated with Buildings 390A, 390M, 390T, and 391 within the SLC-6 area. Building 390 is actually composed of several structures labeled as 390A through 390T. Building 390A was constructed as a mobile service tower (MST) for the Manned Orbital program in 1969. Both past and present hydraulic leaks have been noted at this facility. Building 390M, which is a blast deflector made of concrete, is located west of Building 390A. Both photochemical waste and industrial wastewater releases have occurred within this facility. Building 390T was constructed in 1968 as a contaminated fuel holding area. Although no spills have been documented at this facility, it fits the definition of a potential SWMU under RCRA. Currently, this AOC is being investigated further to determine whether remediation will be required.

3.7 Health and Safety

The risk management framework for health and safety has not changed substantially since the preparation of the 1998 FEIS. The section below provides additional information relevant to health and safety procedures associated with the Proposed Action.

3.7.1 Management of Risks due to Rocket Propellant and Motor Exhaust Constituents Exposures

The exposure criteria used in Eastern and Western Range Safety Programs are used to fulfill toxic hazard and risk management requirements and policies. The objective of these programs is to maximize range operability without compromising public and worker safety. The Headquarters AFSPC Surgeon General (HQ AFSPC/SG) has recommended exposure criteria for some of the current solid- and liquid-rocket propellants and their combustion by-products. HQ AFSPC/SG has also recommended that the Eastern and Western Ranges use a risk-management based approach for developing toxic launch commit criteria (LCC) consistent with current human toxic exposure criteria and coordinated with Local Emergency Planning Committees and local agencies, as needed. In an effort to comply with this recommendation, the Eastern and Western Range Safety offices developed a toxic risk-

management based approach designed to maintain an E_c less than or equal to $30x10^{-6}$ with an individual risk of $1x10^{-6}$ over the varying population densities. This approach takes into account probability of catastrophic failure, concentration, direction, dwell time, and emergency preparedness procedures. This risk level presents no greater risk to the general public for launch and flight of launch vehicles and payloads than that imposed by overflight of conventional aircraft.

For credible potential toxic emissions, tiered levels are established to fulfill Air Force requirements under AFOSH Standard 48-8, Controlling Exposures to Hazardous Materials, and Local Emergency Planning Committee (LEPC) requirements under Executive Order 12856 on Federal Compliance with Right-to-Know laws, Environmental Planning and Community Right-to-Know Act, and Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances, (USEPA, FEMA, DOT 1987).

Both Vandenberg AFB and CCAFS have safety procedures in place, which are described below, to protect the public and sensitive receptors from potential launch impacts.

3.7.2 Western Range Safety Program

The Western Range has a three-tiered, three-zone deterministic approach plus a probabilistic approach to protecting against harmful toxic exposures of HCl. The Western Range implements safety measures that are designed to protect mission essential (ME) and non mission essential (NME) persons. Before launch, the Rocket Exhaust Effluent Diffusion Model (REEDM) is used to locate toxic zones.

There are three zones for assessing an individual's proximity to toxic combustion products, including those that could result from a launch failure. Zone 1 is an area where airborne concentrations of any toxic product are equal to or exceed Tier 1 levels but are less than Tier 2 levels. Zone 2 is an area where airborne concentrations of any toxic product are equal to or exceed Tier 2 levels but are less than Tier 3 levels. Zone 3 is an area where airborne concentrations of any toxic product range from a low defined by Tier 3 to an unknown high. The Tier Levels are described in the text below and in Table 3.7.1-1.

Prior to launch, REEDM is run to ensure that any ME persons within a Zone 2 (having predicted HCl concentrations exceeding the Tier 2 level [see 30 SWI 91-106, 1998]) are aware of being in a Zone 2, have personnel protection equipment, and have a pre-determined route of departure. If ME personnel do not meet these requirements, then they are relocated out of the zone. Any NME persons on-base are also moved, if feasible. If they cannot be moved, or if they are off-base and not subject to being moved, then their locations and exposure are taken into account in the risk assessment procedure.

The Western Range toxic risk-assessment-based recommendation to launch or not to launch is based on the results of the Launch Area Toxic Risk Analysis (LATRA) program (i.e., risk assessment program) that evaluates the risk to people, regardless of whether they are mission essential or NME. Among other criteria in determining whether to launch, LATRA accounts for: (1) whether people are sheltered or unsheltered; (2) whether they are healthy or sensitive individuals; and (3) the probability of a catastrophic launch failure.

3.7.3 Eastern Range Safety Program

The Eastern Range has a risk-management based three-tiered approach for public safety. For off-base public safety, the Eastern Range uses a risk-management-based approach that keeps the risk the same over varying population densities. For on-base CCAFS worker safety, the Eastern Range uses a sheltering program or area evacuation to ensure safety of its work force and visitors. The calculated risks are determined by modeling potential exposures as short-term, acute hazards. If the calculated risks (corresponding to Tier 2 toxic exposure levels) exceed the same risk levels used successfully over the years to protect the general public, then Safety will recommend to the Launch Decision Authority a launch delay until the risks are reduced.

Generally for any toxic commodity, the first tier represents the goal for not exceeding the SPEGL (Short-term Public Emergency Guidance Level) within an individual's breathing zone. The first tier, established for a planned credible event, identifies an action level that would require communication to execute protective actions. The second tier represents the Level of Concern (LOC), a requirement established in coordination with the Local Emergency Planning Commission and the U.S. Air Force/Surgeon General (USAF/SG). For the Eastern Range, LOCs are defined as the maximum acceptable outdoors concentration, which is a function of off-base population density and coordinated risk management. For on-base applications, the LOC is the maximum indoor concentration acceptable per USAF/SG and is a function of shelter air exchange rate, forecasted outdoor plume-dwell time, and forecasted outdoor plume concentration. A third tier exists (which is only for on-base application) as the maximum outdoors capping concentration, regardless of sheltering capability, to prevent fatality to any unanticipated worker not sheltered. The end goal for this process is to manage risk, a function of occurrence probability and resulting consequence, to be in accordance with the risk level requirements presented in EWR 127-1.

For HCl, the Eastern Range uses a first-tier SPEGL of 1ppm ceiling. The off-base second-tier LOC is 15 ppm for high-density populations, 20 ppm for medium density populations, and 25 ppm for low-density populations. For uncoordinated or high probability operations, the off-base LOC for HCl is 10ppm. For on-base-shelter interior LOC, the HCl requirement is 10 ppm. The third tier for HCl is 50 ppm, which is a level one-half the level determined to be Immediately Dangerous to Life and Health (IDLH).

Therefore, launch commit criteria are based on a function of range, bearing, and concentration for on- and off-base critical receptors. In addition, calculation of criteria for on-base risk also accounts for the dwell time of the plume in the vicinity of the on-base critical receptors.

The Eastern Range risk-assessment-based recommendation to launch or not to launch due to the potential hazard of public exposure to toxic commodities is based on the results of the Launch Area Toxic Risk Analysis (LATRA) program (i.e., risk assessment program) that evaluates the risk to the populous. Among other criteria in determining whether to launch, LATRA accounts for: (1) whether people are sheltered or unsheltered; (2) whether they are healthy or sensitive individuals; and (3) the probability of a catastrophic launch failure. Table 3.7.1-1 presents Tier 1, Tier 2, and Tier 3 HQ AFSPC/SG recommended exposure criteria for HCl, anhydrous hydrazine (N_2H_4), UDMH, Aerozine-50 (A-50), MMH, and NO_2 endorsed by HQ AFSPC/SG. It is important to note that the exposure criteria do not take

TABLE 3.7.1-1
HQ AFSPC/SG-Recommended and Endorsed Exposure Criteria for Constituents in Rocket Propellant or Motor Exhaust

	Tier 1[a]	Tier 2[b]	Tier 3[c]
HCl[f]	2 ppm (60 min)[d] 10 ppm[e]	10 ppm[e]	50 ppm[e]
N_2H_4[g]	NR	2 ppm (60 min)[d]	40 ppm[e]
UDMH[g]	NR	5 ppm[e]	25 ppm[e]
A-50[g]	NR	5 ppm[e]	25 ppm[e]
MMH[g]	NR	0.52 ppm (60 min)[d]	25 ppm[e]
NO_2[f]	0.2 ppm (60 min)[d] 2 ppm[e]	2 ppm (60 min)[d] 4 ppm[e]	20 ppm (30 min)[d]
HNO_3[f]	0.3 ppm[e]	2.5 ppm (60 min)[d] 4 ppm[e]	25 ppm (30 min)[d]

[a]Tier 1 – This exposure level and above is defined as the discomfort or mild-effect level. There is little risk to the average person. This exposure poses no hazard to normal and healthy individuals. Sensitive individuals (i.e., asthmatics and bronchitics) may experience some adverse effects, which are reversible. Tier 1 represents exposure guidelines for sensitive members of the general public (off-base) who may involuntarily and unknowingly be exposed. Recommended action, if this tier is exceeded, is similar to a Stage 3 air pollution alert: Notify the public of the release through an advertised announcement particular to an event or a published annual notice that sensitive populations should be advised that there is a possibility of exposure to the effluent and advise of mitigating precautions.

[b]Tier 2 – This exposure level and above is defined as the disability or serious-effect level. All effects are reversible. There are no serious impacts on personnel's ability to complete the mission identified. There is some risk to an average individual. Military and employees voluntarily accept exposure up to Tier 2 concentrations. The consent implies knowledge of the exposure concentrations and the consequences of possible exposure. Tier 2.represents personnel who have knowledge of the event and understand the possibility and consequences of possible exposure (on-base personnel). Personnel are advised to seek immediate protection (shelter in place) or evacuate for concentrations exceeding the Tier 2 limit.

[c]Tier 3 – This exposure level and above is defined as a life-threatening-effect level. Irreversible harm may occur with possible impact on a person's ability to complete the mission. Personnel in an area (event personnel) where Tier 3 exposure may occur have given informed consent and are trained regarding the possible life-threatening situations. Exposures up to Tier 3 concentrations permit an individual to seek shelter or don respiratory protection. Concentrations predicted in excess of Tier 3 concentrations require immediate evacuation to prevent exposure.

[d]Time-weighted average exposure concentration. The time period indicated in parentheses is the time over which the concentration measurements will be measured and averaged.

[e]Ceiling limit. A peak concentration that must not be exceeded during the exposure period.

[f]Exposure criteria recommended by HQ AFSPC/SG.

[g]Exposure criteria recommended by AL/OE and endorsed by HQ AFSPC/SG.

A-50 = Aerozine-50 (50 percent by weight unsymmetrical dimethylhydrazine and anhydrous hydrazine).
HCl = hydrochloric acid.
HNO3 = nitric acid.
HQ AFSPC/SG = Headquarters Air Force Space Command/Surgeon General.
min = minutes.
MMH = monomethyl hydrazine.
NR = no recommendation.
N2H4 = anhydrous hydrazine.
NO2 = nitrogen dioxide.
ppm = parts per million.
UDMH = unsymmetrical dimethylhydrazine.

into account the use of risk mitigating procedures and, therefore, do not accurately depict toxic launch commit criteria used on the two federal ranges. Probabilistic procedures are integral to the risk management approach used on the federal ranges to develop toxic on-base and off-base LCC; therefore, Table 3.7.1-1 should be used only as guidance, and not to evaluate launch availability from the federal ranges.

Tier 1 levels serve as the maximum concentration goal to reach the breathing zone of the public and unprotected workers. Tier 1 levels, typically SPEGLs, are established by Air Force Office of Safety and Health (AFOSH) Standard 48-8 as recommended by the National Academy of Science's Committee on Toxicology and subsequent Air Force Surgeon General guidance. At Vandenberg AFB, all the tier levels are established via 30 SW Instruction 91-106, Toxic Hazard Assessments.

Tier 2 levels are LOCs established by LEPC at CCAFS for potential public exposures. These levels may vary at CCAFS, based on probability of occurrence, potential severity, and readiness of range and local civilian emergency-management authorities to execute emergency response protocols. For potential worker exposures, these levels may be considerably elevated based on worker readiness for sheltering and pre-clearing and air-tightness of the operational shelters.

Tier 3 levels are applicable only for on-base worker scenarios, because these levels exceed any acceptable off-base criteria. The Tier 3 level caps the maximum on-base concentration. This level limits the risk to any unforeseen unprotected worker and certainly exceeds protection factors of on-base shelters.

3.7.4 Composite Materials

Both the Atlas V and the Delta IV vehicles use large amounts of composite materials for numerous components on each vehicle. These materials could, when involved in a launch failure, cause health and safety concerns to the general public. Although these materials are not new to the aerospace industry, sufficient data do not exist concerning the volatile organic compounds that could be produced following a launch failure and their ensuing reactivity with burning solid rocket propellant. The existing literature on the hazards of composite materials mainly deal with aircraft accidents, emergency response, and handling/processing of the materials. To date, data do not exist regarding composite materials used on the Atlas V and Delta IV vehicles and their reactivity with burning solid rocket propellant following a catastrophic launch abort. The Eastern and Western Range safety offices have sent letters to the Atlas V and Delta IV contractors requesting composite material data in an effort to perform a risk assessment of vehicles following a catastrophic launch abort. Technical clarifications and interchanges have taken place between the two Range Safety offices and the EELV contractors regarding composite material data.

3.8 Geology and Soils

Geology and soils were described in the 1998 FEIS.

There have been no substantive changes in these areas since that document was written. For more information on geology and soils, refer to the 1998 FEIS.

3.9 Water Resources

Water resources were described in the 1998 FEIS. Aside from the increased Atlas V launch pad deluge and washdown water usage (refer to Section 2.1.3.1.3 in the FSEIS for further details), there have been no other substantive changes in this area since that document was written. For more information regarding water resources, refer to the 1998 FEIS.

3.10 Air Quality (Lower Atmosphere)

This section describes the air quality environment from ground level to an altitude of 3,000 feet above sea level that could be affected by the Proposed Action or the No-Action Alternative. This section includes only those data that have been updated since publication of the 1998 FEIS.

3.10.1 Federal Regulatory Framework

Air quality for both CCAFS and Vandenberg AFB is regulated by the federal government under Title 40 CFR 50 [National Ambient Air Quality Standards (NAAQS)]; Title 40 CFR 51 (Implementation Plans); Title 40 CFR 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]); Title 40 CFR 70 (Operating Permits); and Title 40 CFR 82 (Protection of Stratospheric Ozone). Only those changes in the regulatory framework that are substantive changes or new information from the description contained in the 1998 FEIS are noted below.

The EPA published new national ambient air quality standards for ozone and particulate matter in the *Federal Register* on July 18, 1997. In May 1999, the Federal Appeals Court nullified the new particulate standard on the basis that the EPA's process of issuing the air pollution rules amounted to "an unconstitutional delegation of legislative power." The court did not vacate the EPA's ozone rule altogether, but said the standard "cannot be enforced" (Associated Press, May 14, 1999). EPA is expected to appeal the ruling.

3.10.2 Cape Canaveral Air Force Station

3.10.2.1 Regional Air Quality

Existing air quality is defined as "in attainment" or "nonattainment" with ambient air quality standards, depending on whether monitored air concentrations exceed the applicable air quality standards presented in the 1998 FEIS. The FDEP operates and maintains monitoring stations throughout Florida. Based on these data, the FDEP classifies areas of the state that are in attainment or nonattainment with the Florida Ambient Air Quality Standards (FAAQS). In Florida, regional air quality is assessed at the county level. CCAFS is in Brevard County, which has been designated by both the EPA and FDEP to be in attainment for all criteria pollutants. Table 3.10-1 lists the FDEP monitoring stations in the vicinity of CCAFS.

Table 3.10-2 shows recent monitored air concentrations around the region. In 1998, the concentrations of particulate matter equal to or less than 10 microns in diameter (PM_{10}) were higher than typical historical figures because of the extensive wildfires within the Florida Everglades.

TABLE 3.10-1
Air Monitoring Locations Near Cape Canaveral Air Force Station

Station	Location	Pollutants Monitored
Brevard County		
Merritt Island	2575 N. Courtenay Parkway, Merritt Island	PM_{10}
Cocoa Beach	400 South 4th Street	O_3
Titusville	Tico Airport, Off U.S. 1	PM_{10}
Titusville	611 Singleton Avenue	PM_{10}
Palm Bay	525 Pepper Street	O_3
Orange County		
Winter Park	Morris Boulevard	SO_2, CO, PM_{10}, NO_2, O_3, lead

PM_{10} = particulate matter equal to or less than 10 microns in diameter.
O_3 = ozone.
O_2 = sulfur dioxide.
CO = carbon monoxide.
NO_2 = nitrogen dioxide.

TABLE 3.10-2
Ambient Air Concentrations near Cape Canaveral Air Force Station

Pollutant ($\mu g/m^3$)	Station	1996[a]	1997[b]	1998[c]
Ozone				
1-hour highest	Cocoa Beach, Brevard Co.	180	190	294
	Palm Bay, Brevard Co.	180	180	220
1-hour 2nd highest	Cocoa Beach, Brevard Co.	170	170	218
	Palm Bay, Brevard Co.	170	170	170
CO				
1-hour highest	Winter Park, Orange Co.	4,600	4,600	4,500
1-hour 2nd highest	Winter Park, Orange Co.	4,600	4,600	4,100
8-hour highest	Winter Park, Orange Co.	2,300	3,400	2,900
8-hour 2nd highest	Winter Park, Orange Co.	2,300	3,400	2,700
NO_x				
Annual	Winter Park, Orange Co.	24	24	21
SO_2				
3-hour highest	Winter Park, Orange Co	126	75	76
3-hour 2nd highest	Winter Park, Orange Co.	75	56	71
24-hour highest	Winter Park, Orange Co.	31	18	21
24-hour 2nd highest	Winter Park, Orange Co.	30	18	18
Annual	Winter Park, Orange Co.	4	4	5
PM_{10}				
24-hour highest	Merritt Island, Brevard Co.	74	33	NA
	Titusville Airport, Brevard Co.	72	32	157
	Titusville Singleton, Brevard Co.	76	42	162

TABLE 3.10-2
Ambient Air Concentrations near Cape Canaveral Air Force Station

Pollutant ($\mu g/m^3$)	Station	1996[a]	1997[b]	1998[c]
24-hour 2nd highest	Merritt Island, Brevard Co.	40	33	NA
	Titusville Airport, Brevard Co.	42	31	64
	Titusville Singleton, Brevard Co.	44	38	148
Annual	Merritt Island, Brevard Co.	18	18	NA
	Titusville Airport, Brevard Co.	16	17	21
	Titusville Singleton, Brevard Co.	18	19	24

[a]1996 ALLSUM Report, Florida Department of Environmental Protection (1997).
[b]1997 ALLSUM Report, Florida Department of Environmental Protection (1998).
[c]1998 ALLSUM Report, Florida Department of Environmental Protection (1999).
[d]Arithmetic Mean.
NA = Not available.
$\mu g/m^3$ = micrograms per cubic meter.

3.10.2.2 Air Emissions

The most recent emission inventories (1996 through 1998) for CCAFS and Brevard County are included in Table 3.10-3.

TABLE 3.10-3
Cape Canaveral Air Force Station and Brevard County Emissions (tons/year)

	VOC	NO_x	CO	SO_2	PM_{10}
CCAFS 1997 Air Emissions Inventory Report[a] (stationary source emissions only)	64.6	402.8	155.6	33.3	70.0
1995 Brevard County Point-Source Emissions	107	11,514	991	26,492	340
1995 Brevard County Area-Source Emissions	24,876	14,608	133,752	1,032	34,750
1995 Brevard County Total Emissions	24,983	26,122	134,743	27,524	35,090

Source: USAF 45th CES/CEV, 1999.
VOC = volatile organic compounds.
NO_x = nitrogen oxides.
CO = carbon monoxide.
SO_2 = sulfur dioxide.
PM_{10} = particulate matter equal to or less than 10 microns in diameter.

3.10.3 Vandenberg AFB

This section describes the site-specific air quality issues for Vandenberg AFB that have been updated since the 1998 FEIS.

3.10.3.1 Regional Air Quality

In California, air quality is assessed on a county and a regional basis. Santa Barbara County is under the jurisdiction of the South Central Coast Air Basin (SCCAB). The SCCAB includes the Counties of San Luis Obispo, Santa Barbara, and Ventura. Table 3.10-4 shows ambient concentrations of the criteria pollutants as measured by monitoring stations located at Vandenberg AFB.

TABLE 3.10-4
Ambient Air Concentrations at Vandenberg AFB

Pollutant ($\mu g/m^3$)	1996	1997	1998
Ozone			
1-hour highest	190	177	157
1-hour 2nd highest	186	167	151
CO			
1-hour highest	1,603	1,259	1,145
1-hour 2nd highest	1,030	1,145	1,030
8-hour highest	801	572	1,030
8-hour 2nd highest	687	572	801
NO_x			
1-hour highest	58	58	43
1-hour 2nd highest	43	51	43
Annual	6	6	6
SO_2			
3-hour highest	8	10	8
3-hour 2nd highest	8	8	8
24-hour highest	3	5	3
24-hour 2nd highest	3	5	3
Annual	3	3	3
PM_{10}			
24-hour highest	61	49	32
24-hour 2nd highest	36	46	31
Annual	18	21	18

$\mu g/m^3$ = micrograms per cubic meter.
CO = carbon monoxide.
NO_x = nitrogen oxides.
SO_2 = sulfur dioxide.
PM_{10} = particulate matter equal to or less than 10 microns in diameter.
Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Monitoring Values Reports, http://www.epa.gov/airsdata/monvals.htm

The California Air Resources Board (CARB) classifies areas of the state that are in attainment or nonattainment of the California Ambient Air Quality Standards (CAAQS).

Both the EPA and CARB have designated the SCCAB as being in attainment of the NAAQS and CAAQS for SO_2, nitrogen dioxide (NO_2), and carbon monoxide (CO). Vandenberg AFB has been designated by the EPA to be in attainment with the federal PM_{10} standard but has been designated by CARB to be in nonattainment with the more stringent California standard for PM_{10}. The EPA has classified Santa Barbara County as being in serious non-attainment for the federal ozone standard.

Federal conformity rules require that all federal actions conform to an approved State Implementation Plan (SIP) or Federal Implementation plan (FIP). Conformity means that an action will not: (1) cause a new violation of the NAAQS; (2) contribute to any frequency or severity of existing NAAQS; and (3) delay the timely attainment of the NAAQS. A detailed description of the conformity rule is described in Appendix J of the 1998 FEIS. Conformity only applies to areas that are not in attainment with the federal standards. Because SCCAB is classified as a serious nonattainment area for the federal ozone NAAQS, conformity must

be considered for NO_x and VOC emissions, which are ozone precursors. A general conformity determination would be required if total EELV emissions exceed 50 tons per year of NO_x or VOC, and/or the Proposed Action results in more than 10 percent of the County emissions inventory. Conformity does not have to be considered for PM_{10} because the area is in attainment with the federal PM_{10} NAAQS (even though the area is in non-attainment for the more stringent state PM_{10} standard).

3.10.3.2 Air Emissions

The most recent emission inventories for Vandenberg AFB and Santa Barbara County are included in Table 3.10-5.

TABLE 3.10-5
Vandenberg AFB and Santa Barbara County Emissions (tons/year)

	VOC	NO_x	CO	SO_2	PM_{10}
1995 Vandenberg AFB Stationary Sources (Emissions Questionnaire)	4.2	21.3	1.2	7.7	2.1
1996 Santa Barbara County Annual Emissions[a]	44,460	16,589	103,369	865	13,553

[a] Source: Santa Barbara County, 1998.
VOC = volatile organic compound.
NO_X = nitrogen oxides.
CO = carbon monoxide.
SO_2 = sulfur dioxide.
PM_{10} = particulate matter equal to or less than 10 microns in diameter.

3.11 Air Quality (Upper Atmosphere)

This section describes the air quality environment in the atmosphere above an altitude of 3,000 feet above sea level. This information summarizes and updates the information contained in the 1998 FEIS.

3.11.1 Troposphere

The atmospheric layer above 3,000 feet is generally referred to as the free troposphere. Within the free troposphere, the air temperature decreases with increasing height. This layer is subject to considerable vertical mixing resulting from various atmospheric processes, including daily solar heating and large-scale weather systems. Because of this mixing, dispersion and removal of most particulate and water-soluble emissions from lift vehicles takes place over a period of less than 1 week, even if released near the top of the troposphere. Emissions in the free troposphere are less likely to contribute to local, ground-level concentrations, but rather would be subject to regional- and global-scale transport and dispersion.

The ROI for the free troposphere is essentially the same for CCAFS and Vandenberg AFB, regardless of the lift vehicle used. Emissions directly into the free troposphere are not subject to any specific regulatory requirements.

3.11.2 Stratosphere

The layer above the troposphere is called the stratosphere. The lower boundary of the stratosphere lies between altitudes of 32,800 feet and 49,000 feet above the Earth's surface at a temperature inversion known as the tropopause. The tropopause is highest at the equator and lowest at the poles. In the stratosphere, the air temperature increases with increasing altitude. This temperature profile promotes a very stable structure subject to little vertical mixing. As a result, emissions released into the stratosphere can remain for long periods of time. For example, stratospheric debris from volcanic eruptions has been observed to stay within the stratosphere for several years after an eruption. The stratosphere extends upward to approximately 164,000 feet (with an atmospheric pressure of about 1 millibar).

Although containing less than 20 percent of the atmosphere's mass the composition of the stratosphere strongly influences the attenuation of solar radiation reaching the Earth's surface. The ozone layer that absorbs most of the biologically damaging ultraviolet sunlight (UV-B) is located within the stratosphere. Because of this layer's protective aspects, there is widespread concern about reductions in stratospheric ozone as a result of human-made ODS that enter the stratosphere. ODS include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halon, methyl bromide, carbon tetrachloride, and methyl chloroform. Class I and class II ODS are listed in section 602 of the Clear Air Act Amendments of 1990. Although released on the ground, most ODS are not water-soluble and have no natural removal mechanism. Therefore, these ODS accumulate (with residence times of fifty to hundreds of years) and become generally evenly mixed throughout the troposphere. The ODS then diffuse into the stratosphere where they react over time with ultraviolet light and split into halogen (chlorine or bromine) molecule and an organic radical. The atomic chlorine or bromine acts as a catalyst in a series of reactions to convert ozone (O_3) to diatomic oxygen (O_2). Because there is no loss of chlorine during the ozone destruction reactions, a single chlorine molecule can lead to the destruction of many ozone molecules.

The loss of the stratospheric ozone results in an increased UV-B flux to the surface of the earth. Higher UV-B fluxes could result in increased damage to the eyes (cataracts), the immune system, and the skin (resulting in sunburn, premature aging, and skin cancer). Increased UV-B may place additional stress on aquatic and terrestrial ecosystems by damaging ultraviolet (UV) sensitive species like phytoplankton and other coastal sea life and plants. Also, high UV-B may result in quicker degradation of synthetic polymers (such as plastics), resulting in more frequent replacement (UNEP, 1998).

In response to the threat of ODS to the stratospheric layer, the international community adopted the Montreal Protocol (and subsequent amendments) to phase out the production of ODS. The EPA implements ODS regulations through Title VI of the Clean Air Act as Amended in 1990 (CAA). However, because of the long residence times of CFC, ODS will continue to contribute more than 100,000 tons of chlorine annually into the stratosphere over the next century (Brady, et al., 1994). Because the stratosphere exchanges mass with the troposphere (albeit at a relatively low rate), the residence time of chlorine containing compounds such as HCl in the stratosphere is on the order of a few years.

No Class I ODS will be utilized in the EELV program; the use of Class II ODS will be minimized or eliminated.

Solid rocket-propelled lift vehicles inject chlorine compounds (Cl_2, HCl, and ClO), nitrogen compounds (NO and N_2), and aluminum oxide (Al_2O_3) particles directly into the stratosphere. Unlike CFCs, rocket exhaust products have stratospheric lifetimes on the order of a few years, depending on the altitude. However, the rocket combustion products can build up over time if there is a sufficient launch rate. The annual amount of chlorine deposited to the stratosphere from lift vehicles globally is generally very small (less than 1 percent), compared to the chlorine release by CFCs globally. As a side note, HCl is water-soluble, so that HCl emitted in the free troposphere would be washed out within a few weeks and would not accumulate as CFCs do.

At the nozzle of a solid rocket motor, most of the chlorine is in the form of HCl. HCl does not directly destroy ozone, but rather is a "reservoir" species for chlorine. However, the effect of the afterburn as the plume cools can convert a substantial amount of HCl (21 to 65 percent, depending on altitude) to free chlorine (Cl and Cl_2) that is immediately available for destroying ozone (Brady and Martin, 1995). This sudden release of chlorine can result in a local depletion of ozone in the daytime when sunlight is available (a "hole") along the vehicle path. The size and duration of the hole depends on the amount of chlorine deposited and the rate of plume dissipation. Exhaust plume chemistry modeling by Brady and Martin (1995) indicated that this free chlorine is the dominant ozone destruction pathway immediately after the passage of an SRM lift vehicle. The conversion of HCl to Cl_2 was verified by stratospheric aircraft measurements by Ross, et al. (1997), and Burke and Zittel (1998).

Besides the chlorine, aerosols from SRMs could also assist in the destruction of ozone by: (1) providing a surface by which two ozone molecules may interact; and (2) providing a surface by which chlorine is freed from a reservoir species like HCl (Brady, et al., 1995). The nitrogen compounds also come into play by interacting with reservoir chlorine compounds to free chlorine. These effects are likely to have more impact in the far field, when the plume has cooled and dispersed.

Molina, et al. (1997) and Hanning-Lee, et al. (1996) have addressed the role of Al_2O_3 from lift vehicles in stratospheric ozone depletion in experiments. Molina, et al. (1997) reported that Al_2O_3 deposition at mid-latitudes could affect ozone concentrations. However, Jackman, et al. (1998) calculated that at current launch rates the global impact from Al_2O_3 would be less than from lift vehicle chlorine emissions.

Several studies have examined the impacts to stratospheric ozone of nitrogen oxides (NO_X) generated by lift vehicles with and without SRMs (Denison, et al., 1994; Zittel, 1995; and Brady, et al., 1997). These studies have found that chlorine compounds dominate the chemistry of ozone depletion.

Pergament, et al. (1977), conducted in-situ measurements of ozone taken after a launch. This study found that 700 seconds after the passage of a Titan III, the ozone concentration at 18 kilometers was approximately 40 percent of the ambient value. Although the ozone depletion at a given point along the trajectory may be significant, if the trajectory is not vertical, only a small portion of the ozone in the column of atmosphere above the launch site may be reduced. Also, effects like the scattering of UV by plume aerosols and the shearing from differences in the winds at different altitudes may help mitigate the short-term impact from a launch. From stratospheric aircraft measurements, Ross, et al. (1997a) reported ozone

concentrations dropped to near zero at daytime, in the wake of a Titan IV lift vehicle with SRMs. They correlated this with elevated chlorine concentrations in the lift vehicle plume. A second study by Ross, et al (1997b) showed elevated chlorine levels but no significant ozone depletion at 18.9 km here following a twilight Titan IV launch.

Prather, et al. (1990), conducted a study of the Space Shuttle's impacts on the stratosphere using two- and three-dimensional models of stratospheric chemistry on a time scale of one day to one month after a launch. Based on their results, and on the fact that the trajectory of the shuttle was not vertical, the authors concluded that no local columnar hole could occur in the ozone above the launch site. The authors supported their position by citing that the total ozone mapping spectrometer (TOMS) should be able to detect a significant hole and that no such hole had been observed (McPeters, et al., 1991). Others (Syage, et al. 1995; Ross, 1992) have since argued that TOMS is not well suited for detecting an ozone hole because of the TOMS spatial resolution, the displacement of the plume over time, and because of spectral interference from other plume species, such as Al_2O_3.

Modeling results reported by Syage, et al. (1995) suggest that a Titan IV launch could result in short-term columnar ozone losses of 20 to 50 percent approximately 3 hours after launch. However, the location and magnitude of a hole would depend on the particular wind and cloud patterns at the time of launch.

McKenzie, et al. (1997) attempted to measure a potential ozone hole using a ground-based imaging spectrometer to measure the UV spectrum before, during, and after a space shuttle launch. There was no evidence of a significant increase in UV radiation from the reduction in the columnar ozone. The measurements were complicated by the presence of clouds and by possible UV scattering by the plume of aerosol particles. At best, the results were inconclusive and indicate the extreme difficulty in conducting this type of study.

Perturbations in the trace gas composition of the stratosphere could potentially affect how the stratosphere absorbs and scatters solar radiation. Therefore, the loss of ozone could have an impact on climate. With less ozone present, more UV passes through the stratosphere, resulting in cooler stratospheric temperatures. Aerosol particles would also scatter solar radiation, thus potentially affecting the thermal balance in the stratosphere.

3.12 Noise

The affected noise environment was described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. New background information on underwater sonic booms is in Appendix O.

3.13 Orbital Debris

Orbital Debris is described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. For information on orbital debris, please refer to the 1998 FEIS.

3.14 Biological Resources

Biological Resources were described in the 1998 FEIS. Although there have been no substantive changes in this area, there are some existing conditions that have changed since that document was written. This section presents updates to the affected environment information.

At CCAFS, the National Marine Fisheries Service (NMFS) designated the water adjacent to portions of the east coast of Florida as critical habitat for the northern right whale, *Eubalaena glacialis,* on June 3, 1994 (50 CFR Part 226). These portions include the southern coast of Georgia (31°15' N) to just south of Cape Canaveral, at approximately Sebastian Inlet, Florida, (28°00' N), to a distance offshore of 5 nautical miles at the Cape. The NMFS also instituted a Take Reduction Plan for the northern right whale and three other whale species on February 16, 1999, to reduce the mortality and serious injury by U.S. commercial fishing operations in the waters specified in the earlier designated critical habitat area (50 CFR Part 229). This more recent plan addresses fisheries activities exclusively, and would not affect the activities of the launch program. However, the designation of critical habitat is a more broad ruling that affects any activity funded, authorized, or carried out by a federal agency that may affect areas required for the continued existence of the whales.

At Vandenberg AFB, the following updated information is provided for wildlife. A request, under Section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended, for a letter of authorization for the incidental take of marine mammals during programmatic operations at Vandenberg AFB was submitted to NMFS in September 1997. The request was accepted, and is effective from March 1, 1999, until December 31, 2003 (1998 FEIS, Appendix H). The request states that Vandenberg AFB is allowed incidental take for up to 20 space launches per year for the next 5 years. The authorization is for Delta II, Taurus, Atlas, Titan IV, Titan II, and LMC lift vehicles.

The recently federally listed California red-legged frog has been added to the Section 7 consultation for current launch programs. Furthermore, the peregrine falcon was changed to state-listed endangered species, and beach west of SLC-3 at Vandenberg AFB has been designated critical snowy plover habitat, by the U.S. Fish and Wildlife Service (USFWS) (Federal Register, December 7, 1999).

3.15 Commercial Fisheries/Managed Species

A total of 206 fish species and invertebrate species is managed by the South Atlantic Fishery Management Council (FMC) and the Pacific FMC in waters off CCAFS and Vandenberg AFB. These species have significant commercial fisheries value associated with them. The Air Force has initiated formal consultation with NMFS and supporting technical information on potential impacts to essential fish habitats (EFH) and managed species is being prepared. A summary of the assessment of the potential effects of the EELV Program on these managed species is presented in Appendix P.

3.16 Cultural Resources

Cultural resources were described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. For information on cultural resources at CCAFS or at Vandenberg AFB, refer to the 1998 FEIS.

3.17 Environmental Justice

Environmental justice was described in the 1998 FEIS. There have been no substantive changes in this area since that document was written. For information on environmental justice at CCAFS or at Vandenberg AFB, refer to the 1998 FEIS.

4.0 Environmental Consequences

4.1 Introduction

This section discusses the potential environmental impacts associated with the Proposed Action and the No-Action Alternative. The baseline condition (No-Action Alternative) was previously analyzed in the 1998 FEIS and allowed for implementation by the ROD. The No-Action Alternative, as described in the 1998 FEIS as the Concept A/B Alternative, will remain part of the existing EELV program, regardless of whether or not the Proposed Action is implemented. LMC will launch the Atlas V MLV without SRMs, and Boeing will launch the Delta IV MLV with GEM-46 SRMs (versus the larger GEM-60 SRMs in the Proposed Action). Impacts can be beneficial or adverse; they can also be described as direct or indirect. The significance of impacts is defined in terms of context and intensity (40 CFR 1508.27).

Potential changes to the local communities, including employment and population, land use and aesthetics, transportation, and utilities are included in this section. In addition, issues related to current and future management of hazardous materials and wastes, as well as health and safety procedures, are discussed. Impacts to the physical and natural environment are evaluated for geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. An environmental justice analysis was conducted to examine potential disproportionately high and adverse impacts to low-income and minority populations. Environmental impacts could occur as a direct result of the Proposed Action, or as an indirect result of changes within the local environment.

Each section within this chapter discusses a separate resource area and describes the potential impacts resulting from implementation of the Proposed Action and the No-Action Alternative. Mitigation measures are described, where applicable. The Proposed Action includes a discussion of the potential impacts of adding SRMs to the Atlas V system, using larger SRMs on the Delta IV system, and the combined effects of these actions. The cumulative impact analysis evaluates the combined effects of other actions with the Proposed Action, both at CCAFS and at Vandenberg AFB. Each section includes an analysis of the potential impacts resulting from the No-Action Alternative, which is the continuation of the previously approved EELV program.

Potential mitigation measures are described for those environmental impacts likely to experience substantial and adverse changes under the Proposed Action or the No-Action Alternative. Potential mitigation measures depend on the particular resource affected. In general, mitigation measures are defined in CEQ regulations as actions that include:

- Avoiding the impact altogether by not taking an action or by not performing certain aspects of the action
- Minimizing the impact by limiting the degree or magnitude of the action and its implementation

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

Mitigation measures that are required by state or federal law, or standard industry practices are generally considered to be part of the Proposed Action. Where impacts have been identified, additional potential mitigation measures beyond those clearly required by law or standard practices are described under each resource area. Such measures include those that the Air Force could implement, or those discretionary mitigation measures available to other governmental entities (such as permit conditions).

4.2 Community Setting

This section describes the direct and indirect impacts to employment, population, and the socioeconomic environment in the communities in which the Proposed Action (Section 4.2.1) would be implemented and the No-Action Alternative (Section 4.2.2) will be implemented.

4.2.1 Proposed Action

This section describes the impacts that would result from the Proposed Action, which includes <u>both</u> the Atlas V and Delta IV systems. The Proposed Action components (Atlas V and the Delta IV systems) are not anticipated to result in impacts to the local or regional economy or to result in growth-inducing impacts, either separately or in combination.

4.2.1.1 Cape Canaveral Air Force Station

4.2.1.1.1 Atlas V System

Employment. Under the Atlas V portion of the Proposed Action at CCAFS, the number of direct and indirect jobs associated with the government launch activities is not anticipated to change from those forecast for the No-Action Alternative. As a result, no impacts to the local or regional economy are expected.

Population. The total number of persons associated with Atlas V system launch activities at CCAFS (including all direct and indirect workers, plus members of their households) is expected to remain at the levels forecast for the No-Action Alternative. As a result, no growth-inducing impacts are expected to occur.

4.2.1.1.2 Delta IV System

Employment. Under the Delta IV portion of the Proposed Action at CCAFS, the number of direct and indirect jobs associated with the government launch activities is not anticipated to change from those forecast for the No-Action Alternative. As a result, no impacts to the local or regional economy are expected.

Population. The total number of persons associated with the Delta IV portion of the Proposed Action launch activities at CCAFS (including all direct and indirect workers, plus members of their households) is expected to remain at the levels forecast for the No-Action Alternative. As a result, no growth-inducing impacts are expected to occur.

4.2.1.2 Vandenberg AFB

4.2.1.2.1 Atlas V System

Employment. Under the Atlas V portion of the Proposed Action at Vandenberg AFB, the number of direct and indirect jobs associated with the government launch activities is not anticipated to change from those forecast for the No-Action Alternative. As a result, no impacts to the local or regional economy are expected.

Population. The total number of persons associated with Atlas V portion of the Proposed Action at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is expected to remain at the levels forecast for the No-Action Alternative. As a result, no growth-inducing impacts are expected to occur.

4.2.1.2.2 Delta IV System

Employment. Under the Delta IV portion of the Proposed Action at Vandenberg AFB, the number of direct and indirect jobs associated with the government launch activities is not anticipated to change from those forecast for the No-Action Alternative. As a result, no impacts to the local or regional economy are expected to occur.

Population. The total number of persons associated with the Delta IV portion of the Proposed Action at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is expected to remain at the levels forecast for the No-Action Alternative. As a result, no growth-inducing impacts are expected to occur.

4.2.1.3 Cumulative Impacts

This section discusses the impacts from other programs within the project vicinity, that, when considered with impacts from the Proposed Action, would result in cumulative impacts to employment, population, and the socioeconomic environment.

4.2.1.3.1 Cape Canaveral Air Force Station

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, no cumulative impacts would result from the Proposed Action.

4.2.1.3.2 Vandenberg AFB

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, no cumulative impacts would result from the Proposed Action.

4.2.2 No-Action Alternative

Project impacts resulting from the No-Action Alternative are described in this section. The No-Action Alternative will occur whether or not the Proposed Action is implemented.

4.2.2.1 Cape Canaveral Air Force Station

Employment. The number of direct and indirect construction-related jobs will increase during construction of the EELV program facilities between 1999 and 2001. Other employment categories will decline as a result of staff restructuring under the Atlas, Delta II, and Titan launch systems until the EELV program is fully staffed in 2007. Overall, there will be a net decline of both direct and indirect jobs. However, these jobs are expected to be compensated by the increases in jobs forecast in the county between 1997 and 2007, resulting in an overall job gain in the region and the CCAFS vicinity.

Population. The total number of persons associated with launch activities at CCAFS (including both direct and indirect workers, and members of their households) will increase during construction of the EELV program facilities, and then will decline by 2007 when the EELV program is fully staffed. It is expected that about 10 percent of residents who are associated with the current launch operations will leave the region surrounding the CCAFS. Others will remain, finding other employment in the area. This effect will not be significant compared to total population in the area, which is forecast to increase during the same period.

4.2.2.2 Vandenberg AFB

Employment. The number of direct and indirect construction-related jobs will increase during construction of the EELV program facilities between 1998 and 2002. Other employment categories will decline as a result of staff restructuring under the Atlas, Delta II, and Titan launch systems until the EELV program is fully staffed in 2007. Overall, there will be a net decline of both direct and indirect jobs. Increases in employment forecast within the county will offset this net decline. It is expected that about 10 percent of the workers associated with the current launch operations who become unemployed will leave the county. Others will remain, finding other employment in the area. This effect on employment in the area will not result in a significant impact.

Population. The total number of persons associated with launch activities at Vandenberg AFB (including both direct and indirect workers, and members of their households) will increase during construction of the EELV program facilities, and then will decline by 2007, when the EELV program is fully staffed. However, population in Santa Barbara County is forecast to increase between 1997 and 2007. Therefore, effects of the No-Action Alternative on population in the vicinity of Vandenberg AFB will not result in a significant impact.

4.3 Land Use and Aesthetics

This section describes the land use and aesthetic impacts that would result from the Proposed Action (Section 4.3.1) and No-Action Alternative (Section 4.3.2).

4.3.1 Proposed Action

This section describes the impacts resulting from the Proposed Action, which includes both the Atlas V and Delta IV systems. The Proposed Action components (Atlas V and Delta IV systems) are not anticipated to result in impacts to regional or local land uses, the coastal zone, recreation, or aesthetics, either separately or in combination.

4.3.1.1 Cape Canaveral Air Force Station

4.3.1.1.1 Atlas V System

Regional Land Use. The Atlas V portion of the Proposed Action would be compatible with existing and planned land uses in the region surrounding CCAFS; therefore, incompatible land uses at a regional level would not result.

CCAFS Land Use. The land uses proposed under the Proposed Action (space launch and support activities) would be consistent with the Base Comprehensive Plan and the continuing mission of the Air Force at CCAFS. Additionally, there would be no conversion of prime agricultural land, nor would it cause a decrease in the use of land. Therefore, the development of the Proposed Action would not result in significant land use impacts to CCAFS.

Coastal Zone Management. The construction and operational activities associated with the Proposed Action are not substantially different from those analyzed under the 1998 FEIS. As a result, no new impacts to the coastal zone or the management of the coastal zone are anticipated. The FDEP issued a concurrence with the original EELV program on June 30, 1998, stating that the alternatives presented in the 1998 FEIS were found to be consistent with the Florida Coastal Management Plan (FCMP). Based on an evaluation of the potential effects of the Proposed Action on the coastal zone, the Air Force has determined that the EELV program is consistent with the Florida Coastal Management Act (FCMA).

Recreation. Public recreation would not be affected because there are no public beaches or other public facilities in the launch area on CCAFS.

Aesthetics. No ground disturbance is anticipated at SLC-41 for the Atlas V system under the Proposed Action. As a result, the addition of SRMs to the Atlas V system would not affect the area's aesthetic quality or obscure any scenic views.

4.3.1.1.2 Delta IV System

Regional Land Use. The Proposed Action would be compatible with existing and planned land uses in the region surrounding CCAFS; therefore, there would be no incompatible land uses at a regional level.

CCAFS Land Use. Some minor ground disturbance would occur as the result of widening turns to accommodate SRM transport vehicles. However, the Proposed Action would continue to be consistent with the Base Comprehensive Plan and the mission of the Air Force at CCAFS. Additionally, the Delta IV system with larger SRMs would not result in conversion of prime agricultural land or cause a decrease in the use of land. Therefore, the development of the Proposed Action would not result in any significant land use impacts on CCAFS.

Coastal Zone Management. The Air Force has determined that the Delta IV portion of the Proposed Action is consistent with the FCMA for the same reasons as stated in the Coastal Zone Management portion of Section 4.3.1.1.1, above.

Recreation. Public recreation would not be affected because there are no public beaches or other public facilities in the launch area on CCAFS.

Aesthetics. No ground disturbance is anticipated at SLC-37 for the Delta IV system. As a result, the Delta IV system with larger SRMs would not affect the area's aesthetic quality nor would it obscure any scenic views.

4.3.1.2 Vandenberg AFB

4.3.1.2.1 Atlas V System

Regional Land Use. The Proposed Action Atlas V system would be compatible with existing and planned land uses in the region surrounding Vandenberg AFB; therefore, there would be no incompatible land uses at a regional level.

Vandenberg AFB Land Use. The Atlas V system in the Proposed Action at Vandenberg AFB would continue existing use of the land. As a result, the Proposed Action would continue to be consistent with the Base Comprehensive Plan and the mission of the Air Force at Vandenberg AFB.

Additionally, the Proposed Action would not result in conversion of prime agricultural land or cause a decrease in the use of old land. Therefore, the development of the Proposed Action would not result in any significant land use impacts on Vandenberg AFB.

Coastal Zone Management. As defined in the Coastal Zone Management Program (CZMP), federal activities in or affecting a coastal zone must be consistent with the CZMP. The California Coastal Commission issued a concurrence on May 19, 1998, stating that the EELV program was found to be consistent to the maximum extent practicable with the California Coastal Management Program. This concurrence was issued in response to Air Force commitments for further communication with the Commission as issues such as dredging, potential wetland impacts, and threatened and endangered species impacts were addressed and resolved with other agencies. Regarding the coastal zone, the Proposed Action does not substantially differ from the No-Action Alternative, described as part of the 1998 FEIS.

Recreation. All SRM-augmented Atlas V launches would occur at SLC-3W, which would result in the closure of Ocean Beach County Park. Jalama Beach County Park would also be closed for low-azimuth launches (approximately 180 degrees or less). A maximum of five launches would occur during the expected peak year (2008). The parks would be closed prior to, during, and immediately following low-azimuth launches to ensure public safety, in coordination with local and state agencies. In order to reduce the recreation impacts of beach closures, the Air Force has made a commitment to consider avoiding weekends, holidays, and peak recreation seasons during launch planning and scheduling for the EELV operations.

Aesthetics. Views of Vandenberg AFB from public beaches, marine vessels, and railroad tracks would not be affected by the Proposed Action because no new construction would occur other than that for the No-Action Alternative. Views of South Vandenberg AFB are limited by topography. In addition, most public views are distant views. Therefore, the Proposed Action would not affect the area's aesthetic quality nor would it obscure any scenic views.

4.3.1.2.2 Delta IV System

Regional Land Use. The Delta IV system with larger SRMs would be compatible with existing and planned land uses in the region surrounding Vandenberg AFB; therefore, there would be no incompatible land uses at a regional level.

Vandenberg AFB Land Use. No new ground-disturbing construction that would affect land use would be required for the Delta IV system with larger SRMs at Vandenberg AFB. As a result, the Proposed Action would continue to be consistent with the Base Comprehensive Plan and the mission of the Air Force at Vandenberg AFB. Additionally, the use of larger SRMs on Delta IV vehicles would not result in conversion of prime agricultural land or cause a decrease in the use of old land. Therefore, the development of the Proposed Action would not result in any significant land use impacts on Vandenberg AFB.

Coastal Zone Management. As defined in the CZMP, federal activities in or affecting a coastal zone must be consistent with the CZMP. See Section 4.3.1.2.1 for a discussion of the California Commission's concurrence with the Air Force's determination that the EELV program is consistent with the state's Coastal Management Plan. Regarding the coastal zone, the Proposed Action does not substantially differ from what is now known as the No-Action Alternative.

Recreation. All proposed Delta IV launches would occur at SLC-6, which would not result in the closure of Ocean Beach County Park. However, Jalama Beach County Park would be closed for low-azimuth launches (approximately 180 degrees or less). A maximum of five launches would occur during the expected peak year (2007). The park would be closed prior to, during, and immediately following all low-azimuth launches to ensure public safety, in coordination with state and local agencies. In order to reduce the recreation impacts of beach closures, the Air Force has made a commitment to consider avoiding weekends, holidays, and peak recreation seasons during launch planning and scheduling for EELV operations.

Aesthetics. Views of Vandenberg AFB from public beaches, marine vessels, and railroad tracks would not be affected by the Proposed Action because no new construction would occur other than that for the No-Action Alternative. Views of South Vandenberg AFB are limited by topography. In addition, most public views are distant views. Therefore, the Delta IV system with larger SRMs would not affect the area's aesthetic quality nor would it obscure any scenic views.

4.3.1.3 Cumulative Impacts

This section discusses the impacts from other programs within the project vicinity that, considered with impacts from the Proposed Action, would result in cumulative impacts to land use and aesthetics.

4.3.1.3.1 Cape Canaveral Air Force Station

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, no cumulative impacts would result from the Proposed Action.

4.3.1.3.2 Vandenberg AFB

The Proposed Action would not result in any impacts to regional or local land uses, or aesthetic opportunities. Occasional beach closures would result in less-than-significant project impacts that cannot be mitigated. However, public officials in the surrounding jurisdictions stated that there were no other projects in the area that would result in impacts to the area's beaches or other recreation resources. Therefore, no cumulative impacts would result from the Proposed Action.

4.3.2 No-Action Alternative

Project impacts resulting from the No-Action Alternative are summarized in this section from the 1998 FEIS, which describes them more fully. The No-Action Alternative will occur whether or not the Proposed Action is implemented.

4.3.2.1 Cape Canaveral Air Force Station

In general, the No-Action Alternative will be compatible with existing and planned land uses both on and surrounding CCAFS. No conversion of prime agricultural land or decreased use of land will result.

An evaluation of the effects of the No-Action Alternative on the coastal zone by the Air Force has shown that the No-Action Alternative is consistent with the FCMA. The FDCA concurred with this determination on June 30, 1998.

No adverse impacts to public recreation will result because no public beaches or facilities are located within the area of impact.

Views of CCAFS from public beaches, marine vessels, and surrounding communities will change slightly from new construction. Views of CCAFS are primarily limited to marine traffic on the east and west, and distant offsite beach areas and small communities to the south. However, these views are distant views, and any changes will not be significant.

4.3.2.2 Vandenberg AFB

In general, the No-Action Alternative will be compatible with existing and planned land uses both on and surrounding Vandenberg AFB. No conversion of prime agricultural land or decreased use of land will result.

The No-Action Alternative will result in public beach closures. As a result of these closures and other impacts within the coastal zone, the Air Force submitted a Coastal Zone Consistency Determination for the No-Action Alternative to the California Coastal Commission for review. The California Coastal Commission concurred with this determination on May 19, 1998.

In order to reduce the recreation impacts of beach closures, the Air Force has made a commitment to consider avoiding weekend launches, especially on holiday weekends, and during the peak recreation seasons (usually May through September) when planning and scheduling for EELV launch operations.

Views of Vandenberg AFB from public beaches, marine vessels, and railroad tracks will be slightly altered by the No-Action Alternative construction activities. However, the nearest public views are those seen by passengers aboard moving trains on the Southern Pacific

Railroad line that runs through the Base. Views from the south are limited by topography, and most views are distant views. Additionally, construction of the No-Action Alternative would not significantly change the scenic views of the area. As a result, no significant aesthetic impacts are expected.

4.4 Transportation

The impacts to key roadways and railroads expected to be affected by the Proposed Action and No-Action Alternative are described in this section.

4.4.1 Proposed Action

This section describes the impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems. The Proposed Action components, either in combination or separately, are not anticipated to result in transportation impacts.

4.4.1.1 Cape Canaveral Air Force Station

4.4.1.1.1 Atlas V System

Roadways. The addition of SRMs to Atlas V vehicles at CCAFS would not necessitate the construction of any new launch or operations facilities. Minor interior construction would not generate significant construction traffic. As a result, construction vehicles would not affect roadway traffic on and surrounding CCAFS. An increase in the number of launches per year (42 launches total for the entire 20-year project period) is expected to cause only a slight increase in traffic compared to the No-Action Alternative. This increase would result from an increase in the number of employees, visitors, and service vehicles associated with launch operations. Overall, the increased number of vehicle trips is not expected to result in a change to the projected level of service (LOS) on local roads and intersections.

Regional traffic is not expected to be affected by the addition of SRMs to Atlas V vehicles at CCAFS.

Railways. Railroad traffic is not expected to be affected by the addition of SRMs to Atlas V vehicles at CCAFS.

4.4.1.1.2 Delta IV System

Roadways. The use of larger SRMs on Delta IV vehicles at CCAFS would not necessitate the construction of new launch or operations facilities. Minor interior construction and paving activities in the vicinity of the RIS would not cause significant construction traffic. As a result, construction vehicles would not affect roadway traffic on and surrounding CCAFS. The increase in the number of launches per year (45 launches total for the entire 20-year project period) is expected to result in a slight increase in traffic compared to the No-Action Alternative. This increase would be the result of an increase in the number of employees, visitors, and service vehicles associated with launch operations. Overall, the increased number of vehicle trips is not expected to result in a change to the projected LOS on local roads and intersections.

Regional traffic is not expected to be affected by the use of larger SRMs on Delta IV vehicles at CCAFS.

Railways. Railroad traffic is not expected to be affected by the use of larger SRMs on Delta IV vehicles at CCAFS.

4.4.1.2 Vandenberg AFB

4.4.1.2.1 Atlas V System

Roadways. The addition of SRMs to Atlas V vehicles at Vandenberg AFB would not necessitate the construction of new launch or operations facilities. Minor interior construction would not generate significant construction traffic. As a result, construction vehicles would not affect roadway traffic on and surrounding Vandenberg AFB. The increase in the number of launches per year (5 launches total for the entire 20-year project period) is expected to result in only a slight increase in traffic, if any, when compared to the No-Action Alternative. This slight increase would be the result of an increase in the number of employees, visitors, and service vehicles associated with launch operations. Overall, the small increase in the number of vehicle trips is not expected to result in a change to the projected LOS on local roads and intersections.

Discussed in Section 4.5, Atlas V launches will require the use of water for cooling, acoustic suppression, and washdown. Of the 600,000 gallons used per launch, approximately 300,000 gallons will be collected and transported off-base to a wastewater treatment facility. This will occur in both the Proposed Action and the No-Action Alternative. The 1998 FEIS reported that this water removal would require approximately 8 truck trips per launch. However, updated water requirements indicate that this wastewater removal will require 60 truck trips per launch. Again, this increase in vehicle traffic would not be an increase over the No-Action Alternative and is not expected to result in a change to the projected LOS on local roads and intersections.

Regional traffic is not expected to be affected by the addition of SRMs to Atlas V vehicles at Vandenberg AFB.

Railways. Railroad traffic is not expected to be affected by the addition of SRMs to Atlas V vehicles at Vandenberg AFB.

4.4.1.2.2 Delta IV System

Roadways. The use of larger SRMs on Delta IV vehicles at Vandenberg AFB would not necessitate the construction of new launch or operations facilities. Minor interior construction would not cause significant construction traffic. As a result, construction vehicles would not affect roadway traffic on and surrounding Vandenberg AFB. The increase in the number of launches per year (2 launches total for the entire 20-year project period) is expected to result in a slight increase in traffic when compared to the No-Action Alternative. This slight increase would result from an increase in the number of employees, visitors, and service vehicles associated with launch operations. Overall, the increased number of vehicle trips is not expected to result in a change to the projected LOS on local roads and intersections.

Regional traffic is not expected to be affected by the use of larger SRMs on Delta IV vehicles at Vandenberg AFB.

Railways. Railroad traffic is not expected to be affected by the use of larger SRMs on Delta IV vehicles at Vandenberg AFB.

4.4.1.3 Cumulative Impacts

This section discusses the impacts from other programs within the project vicinity that, considered with impacts from the Proposed Action, would result in cumulative impacts to transportation.

4.4.1.3.1 Cape Canaveral Air Force Station

The Proposed Action would not result in any impacts to the regional or local road or railroad traffic. Therefore, no cumulative impacts would result.

4.4.1.3.2 Vandenberg AFB

The Proposed Action would not result in any impacts to the regional or local road or railroad traffic. Therefore, no cumulative impacts would result.

4.4.2 No-Action Alternative

Impacts resulting from the No-Action Alternative are discussed in this section. These impacts will occur whether or not the Proposed Action is implemented.

4.4.2.1 Cape Canaveral Air Force Station

The No-Action Alternative at CCAFS will add approximately 500 vehicles to the Samuel C. Phillips Parkway/Hangar Road, resulting in an increased peak-hour traffic volume. The LOS on the Samuel C. Phillips Parkway/Hangar Road will remain at LOS A. Of these 500 additional vehicles, approximately 100 will exit CCAFS to the west via the NASA Causeway. The remaining 400 vehicles will continue south and exit CCAFS at Gate 1. This temporary increase in the peak-hour traffic will cause the LOS on SR A1A to change from B to C.

By 2015, the No-Action Alternative will generate approximately 400 additional trips during the afternoon peak hour. The peak-hour traffic on the Samuel C. Phillips Parkway is expected to decline with the completion of all project-related construction; however, the LOS will not be affected by the reduced traffic volumes. Traffic exiting the base via the NASA Causeway or Gate 1 will not adversely affect the local road system.

4.4.2.2 Vandenberg AFB

The No-Action Alternative at Vandenberg AFB will add approximately 500 vehicles to the Coast and Bear Creek Roads, resulting in an increased peak-hour traffic volume. The LOS on Bear Creek Road will change from A to C, and the LOS on 13th Street will change from D to E. When distributed to the local road system, the construction-related traffic will increase peak-hour traffic volumes exiting the base by approximately 250 vehicles at each existing location.

By 2015, the No-Action Alternative will generate approximately 300 additional trips during the afternoon peak hour; however, the peak-hour traffic on Coast and Bear Creek Roads is expected to decline overall with the completion of all project-related construction. The LOS on Bear Creek Road will improve from LOS C to A, and the LOS on 13th Street will improve from E to D. Traffic exiting the base via Ocean Avenue from Bear Creek Road, or via the Santa Maria Gate, will not adversely affect the local road system.

As discussed in Section 4.5, launches will require the use of water, which will be collected and either transported off-base to a wastewater treatment facility or be treated on-site and recycled. The 1998 FEIS reported that this water removal would require approximately 8 trucks per launch. However, updated water requirements indicate that this wastewater removal will require 60 truck trips per launch. This increase in vehicle traffic is not expected to result in a change to the projected LOS on local roads and intersections.

4.5 Utilities

The utility systems addressed in this analysis include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity.

4.5.1 Proposed Action

This section describes the impacts to utilities that would result from the Proposed Action, which includes both the Atlas V and the Delta IV systems. The Proposed Action at both CCAFS and Vandenberg AFB would not result in significant impacts to the water supply or distribution systems. Water would be required for various launches, but the quantity would not be an increase over the No-Action Alternative. The maximum amount of water needed per launch would be 600,000 gallons for Atlas V launches and 185,000 gallons for Delta IV launches. Total water usage is discussed in this section and in Section 4.9, Water Resources.

In addition, the Proposed Action at CCAFS and Vandenberg AFB would not result in significant impacts to the wastewater, solid waste, and electrical distribution systems.

4.5.1.1 Cape Canaveral Air Force Station

4.5.1.1.1 Atlas V System

Water Supply. As discussed in Section 2.0, the Atlas V portion of the Proposed Action would not necessitate any ground disturbance. Any necessary building modifications would not significantly affect the amount of water needed for the Proposed Action. The number of launch operations staff is not anticipated to change from the No-Action Alternative and, consequently, water usage by personnel would not change. Atlas V launches using SRMs would need cooling, acoustic damping, and washdown water. The maximum amount of water needed per launch would be 600,000 gallons of which approximately 300,000 gallons would be recovered. This water usage would be the same as the No-Action Alternative. During the expected peak launch year (2008), Atlas V launch activities at CCAFS (12 launches) would require approximately 7.2 million gallons of water. Each launch would require approximately 2.3 percent of the more than 26 million gallons of water used within the region per day (Hearst, 1999).

Wastewater. The Atlas V portion of the Proposed Action would not necessitate any ground-disturbing construction. Any building modifications related to the Proposed Action would not significantly affect the amount of wastewater generated. Additionally, wastewater generated by launch operations would not change from the forecast in the No-Action Alternative. As a result, there would be no significant change in the amount of wastewater generated by the Proposed Action. All regional systems are anticipated to operate within capacity, and no project-related impacts are anticipated.

As discussed in Section 4.9, launches would require water for sound suppression, cooling, and washdown. Half of the water will be collected during and after the launch. Collected water would be tested for contamination. Because this water is anticipated to be within permitted limits, the water could be released to grade. If the wastewater exceeds permitted limits, then the water within the deluge basin would be allowed to settle, be pH adjusted, and then would be released to grade providing that permit conditions are met. If permit conditions are not met, the wastewater will be released to the Cape Canaveral AFS sewer system, upon Air Force approval. The LVC would obtain all necessary industrial wastewater permits. The amount of wastewater generated would not change from the No-Action Alternative.

Solid Waste. The Atlas V portion of the Proposed Action would not necessitate any ground-disturbing construction for the Proposed Action, so no project-related solid waste is expected. Any necessary building modifications would only contribute small amounts to the solid waste generated. Solid waste generated by launch operations staff is not anticipated to significantly change from the forecast in the No-Action Alternative. As a result, there would be no significant change in the amount of solid waste generated.

Electricity. No changes in electrical consumption are anticipated from the Atlas V portion of the Proposed Action, because no construction is necessary. Any changes in electrical consumption during the operational phase of the Proposed Action would be slight, and would not affect the station's electrical distribution system. No measurable changes in electrical consumption are expected to occur off-station.

4.5.1.1.2 Delta IV System

Water Supply. As discussed in Section 2.0, the use of larger SRMs on Delta IV vehicles would require some paving activity around the RIS at CCAFS. This construction would not require a significant volume of water. Any necessary building modifications would only require a small amount of water. The number of launch operations staff would not change; therefore, water usage by personnel or for construction would not change significantly from the forecast in the No-Action Alternative. The use of larger SRMs on Delta IV vehicles would not change the quantity of water needed for launch activities. The 1998 FEIS reported a total use of 125,000 gallons of IPS water per launch, with an additional 30,000 gallons for washdown. The updated water requirement for all Delta IV vehicles (Proposed Action and No-Action Alternative) has been revised to include a total of 60,000 gallons for washdown water, for a total water use per launch of 185,000 gallons. This water usage will occur with or without the Proposed Action. During the expected peak launch year (2006), Delta IV launch activities at CCAFS (14 launches) would require approximately 2,590,000 gallons of water. Each launch would require approximately 0.71 percent of the more than 26 million gallons of water used within the region per day (Hearst, 1999).

Wastewater. The Delta IV portion of the Proposed Action would require some minor paving activity at CCAFS. This roadwork is not anticipated to generate a significant amount of wastewater. Any necessary building modifications would only generate a small amount of additional wastewater. Additionally, wastewater generated by launch operations would not change from the forecast in the No-Action Alternative. As a result, there would be no significant change in the amount of wastewater generated. All regional systems are anticipated to operate within capacity, and no project-related impacts are anticipated.

As discussed in Section 4.9, launches would require washdown water and Ignition Pulse Suppression (IPS) water. This water would be collected after washdown is complete and be tested for contamination. If this water is within permitted limits, as anticipated, it could be released to grade. If the wastewater exceeds permitted limits, then the water within the flame duct would be allowed to settle before being pH adjusted, then it would be released to grade. The LVC would obtain all necessary industrial wastewater permits. The amount of wastewater generated would not change from the No-Action Alternative.

Solid Waste. The Delta IV portion of the Proposed Action would only require minor paving activities. These modifications to roadways around the RIS are not anticipated to generate a significant amount of solid waste. Any necessary building modifications would only generate a small amount of additional solid waste. Solid waste generated by launch operations is not anticipated to change from the forecast in the No-Action Alternative. As a result, there would be no significant changes in the amount of solid waste generated.

Electricity. No changes in electrical consumption are anticipated from paving for the Proposed Action. Any changes in electrical consumption during the operational phase of the Proposed Action would be slight, and would not affect the station's electrical distribution system. No measurable changes in electrical consumption are expected to occur off-station.

4.5.1.2 Vandenberg AFB

4.5.1.2.1 Atlas V System

Water Supply. The Atlas V portion of the Proposed Action would not necessitate any ground disturbance. Any necessary building modifications would not significantly affect the amount of water needed for the Proposed Action. The number of launch operations staff is not anticipated to change from the No-Action Alternative and would, therefore, not result in new demands on potable water. Atlas V launches using SRMs would need cooling, acoustic damping, and washdown water. The maximum amount of water needed per launch would be 600,000 gallons, of which approximately 300,000 gallons would be recovered. This water usage would be the same as the No-Action Alternative. During the expected peak launch year (2008), Atlas V launch activities at Vandenberg AFB (5 launches) would require approximately 3 million gallons of water. This amount can be provided by Vandenberg AFB's current contract to receive nearly 5 million gallons of water per day from the State Water Project.

Wastewater. The Atlas V portion of the Proposed Action would not necessitate any ground-disturbing construction. Any necessary building modifications would not significantly affect the amount of wastewater generated. Additionally, wastewater generated by launch operations would not change from the forecast in the No-Action Alternative. As a result, there would be no change in the amount of wastewater generated. All regional systems are anticipated to operate within capacity, and no project-related impacts are anticipated.

As discussed in Section 4.9, launches would require water for sound suppression, cooling, and washdown. Half of this water will be collected during and after the launch. Collected water would be transported off-site to an approved facility for treatment and disposal.

Solid Waste. The Atlas V portion of the Proposed Action would not necessitate any ground-disturbing construction, so no project-related solid waste is expected. Any necessary building modifications would not significantly affect the amount of solid waste generated.

Solid waste generated by launch operations staff is not anticipated to change from the forecast in the No-Action Alternative. As a result, there would be no significant changes in the amount of solid waste generated.

Electricity. No changes in electrical consumption are anticipated from the Atlas V portion of the Proposed Action, since no construction is necessary. Any changes in electrical consumption during the operational phase of the Proposed Action would be slight, and would not affect the base's electrical distribution system. No measurable changes in electrical consumption are expected to occur off-base.

4.5.1.2.2 Delta IV System

Water Supply. As discussed in Section 2.0, the use of larger SRMs on Delta IV vehicles would not necessitate any ground-disturbing construction at Vandenberg AFB. Any necessary building modifications would not significantly affect the amount of water needed for the Proposed Action. The number of launch operations staff would not change; therefore, water usage by personnel would not change from the forecast in the No-Action Alternative. The use of larger SRMs on Delta IV vehicles would not change the quantity of water needed for launch activities. Delta IV launches would not require the use of deluge water, or acoustic suppression water. The 1998 FEIS reported a total use of 125,000 gallons per launch of IPS water, with an additional 30,000 gallons for pad washdown. The updated water requirement for all Delta IV vehicles (Proposed Action and No-Action Alternative) is 60,000 gallons of washdown water per launch for a total of 185,000 gallons per launch. This water usage would occur with or without the Proposed Action. During the expected peak launch year (2007), Delta IV launch activities at Vandenberg AFB (five launches), would require approximately 925,000 gallons of water. Vandenberg AFB has adequate coverage under current contracts be supplied this amount, see Section 4.9, Recycled Water Resources.

Wastewater. The Delta IV portion of the Proposed Action would not necessitate any ground-disturbing construction. Any necessary building modifications would not significantly affect the amount of wastewater generated. Additionally, wastewater generated by launch operations would not change from the forecast in the No-Action Alternative. As a result, there would be no change in the amount of wastewater generated. All regional systems are anticipated to operate within capacity, and no project-related impacts are anticipated.

As discussed in Section 4.9, launches would require the use of washdown and IPS water. This water would be collected after washdown is complete and would be tested for contamination. It is expected that this water would exceed permitted limits as a result of stringent State of California regulations and would require treatment. Treatment would occur onsite at a mobile treatment facility and the water would be recycled. The LVC would obtain all necessary industrial wastewater permits. The amount of wastewater generated would not change from the No-Action Alternative.

Solid Waste. The Delta IV portion of the Proposed Action would not necessitate any ground-disturbing construction at Vandenberg AFB, so no project-related solid waste is expected. Any necessary building modifications would not significantly affect the amount of solid waste generated. Solid waste generated by launch operations staff is not anticipated to change from the forecast in the No-Action Alternative. As a result, there would be no significant changes in the amount of solid waste generated.

Electricity. No changes in electrical consumption are anticipated, since no construction is necessary at Vandenberg AFB. Any changes in electrical consumption during the operational phase of the Proposed Action would be slight, and would not affect the base's electrical distribution system. No measurable changes in electrical consumption are expected to occur off-base.

4.5.1.3 Cumulative Impacts

This section discusses impacts from other projects within the project vicinity, that, when considered with impacts from the Proposed Action, would result in cumulative impacts to utilities.

4.5.1.3.1 Cape Canaveral Air Force Station

The Proposed Action would not result in any impacts to the water supply, wastewater treatment, solid waste, or electrical systems. Therefore, no cumulative impacts would result.

4.5.1.3.2 Vandenberg AFB

The Proposed Action at Vandenberg AFB would not result in any impacts to the water supply, wastewater treatment, solid waste, or electrical systems. Consequently, no cumulative impacts would result.

4.5.2 No-Action Alternative

Impacts resulting from the No-Action Alternative are discussed in this section. The No-Action Alternative will be implemented whether or not the Proposed Action is implemented.

4.5.2.1 Cape Canaveral Air Force Station

Water Supply. During the preparation of the 1998 FEIS, maximum per-launch water usage of 59,000 gallons was estimated to be necessary for the Atlas V launches and 155,000 gallons for Delta IV launches, respectively. These values were based on the requirements of similar lift vehicles. More definitive design data now indicate that the No-Action Alternative will require per-launch water usage of 600,000 gallons for Atlas V launches and 185,000 gallons for Delta IV launches, as indicated in Section 2.0. Using the revised requirement for water supply for the No-Action Alternative, potable water usage will be greater than current usage, and the average daily water consumption on CCAFS will increase slightly. The existing system is capable of absorbing the increased water use and no adverse impacts are anticipated.

Employment decreases will reduce the requirements for potable water for use by staff personnel by approximately 3.7 percent from current levels. Potable water required to support launches will total approximately 7.2 million gallons during the peak water usage year (2008). These changes in potable water requirements are not expected to have adverse impacts on the regional water systems, and the systems will continue to operate within capacity.

Wastewater. Construction of facilities and launch operations to support the No-Action Alternative will increase the volume of wastewater generated, particularly as a result of the use of launch activity water. The existing wastewater system will be capable of absorbing the increase. During the operational phase, employment on the station will decrease, which will reduce the amount of wastewater generated. Industrial wastewater will be handled

appropriately by the contractors and will be the same as discussed in Sections 4.5.1.1.1 and 4.5.1.1.2. Regional systems will continue to operate within capacity and no adverse impacts are anticipated. The LVCs will obtain all necessary industrial wastewater permits.

Solid Waste. Approximately 9,800 tons of construction debris are expected to be generated during the construction phase of the No-Action Alternative as a result of facility demolition, construction, and modification. The majority of the debris will be concrete (4,550 tons), which will be crushed and reused as aggregate and structural fill on the project site, if possible. The other debris materials will be recycled, including wood (120 tons), asphalt (1,650 tons), structural steel (2,200 tons), fire brick (280 tons), paper (10 tons), and copper and miscellaneous metal (330 tons). The remaining 640 tons of construction debris will be disposed of in sanitary landfills permitted to accept the waste.

Electricity. Electrical consumption during construction will continue at the levels described in Section 3.5. No impacts are anticipated.

4.5.2.2 Vandenberg AFB

Water Supply. During the preparation of the FEIS, maximum per-launch water usage of 59,000 gallons was estimated for Atlas V launches and 155,000 gallons for Delta IV launches respectively. These values were based on the requirements of similar lift vehicles. More definitive design data now indicate that the No-Action Alternative will require per-launch water usage of 600,000 gallons for Atlas V launches and 185,000 gallons for Delta IV launches, as indicated in Section 2.0. Using the revised requirement for water supply for the No-Action Alternative at Vandenberg AFB, potable water use will increase slightly. The existing system is capable of absorbing the increase and no impacts are anticipated.

Employment decreases will reduce the requirements for potable water for use by staff personnel by approximately 0.3 percent. Potable water required to support launches will total approximately 3 million gallons during the peak water usage year (2008). These changes in potable water requirements are not expected to have adverse impacts on the regional water systems, and the systems will continue to operate within capacity.

Wastewater. Construction of facilities and launch operations to support the No-Action Alternative will increase wastewater. The existing system will be capable of absorbing the increase. During the operational phase, employment on the base will decrease, which will reduce the amount of wastewater generated. Industrial wastewater will be handled appropriately by the contractors and will be the same as discussed in Sections 4.5.1.2.1 and 4.5.1.2.2. Regional systems will continue to operate within capacity and no adverse impacts are anticipated. The LVC will obtain all necessary industrial wastewater permits.

Solid Waste. Approximately 17,300 tons of construction debris is expected to be generated during the construction phase of the No-Action Alternative as a result of facility demolition, construction, and modification. The majority of the debris will be concrete (12,750 tons), which will be crushed and reused as aggregate and structural fill on the project site. The other debris materials will be recycled, including wood (120 tons); copper (18 tons); asphalt (500 tons); structural steel (2,400 tons); and miscellaneous rails, fencing, piping, and wire (1,000 tons). The remaining 500 tons of construction debris will be disposed of in sanitary landfills permitted to accept the waste.

Electricity. Electrical consumption during construction will continue at the levels described in Section 3.5. No impacts are anticipated.

4.6 Hazardous Materials and Hazardous Waste Management

This section addresses potential environmental impacts caused by hazardous materials and waste management practices of the Proposed Action and the No-Action Alternative, including the potential impacts at CCAFS and Vandenberg AFB on the ongoing remediation activities at existing contaminated sites.

The government will continue to remediate all contamination associated with sites proposed for use under the EELV program. Delays or restrictions on facility use or launch sites may occur, depending on the extent of contamination and the results of remedial actions determined for contaminated sites.

Regulatory standards and guidelines have been applied in determining the potential impacts associated with the use of hazardous materials and the generation of hazardous wastes. The following criteria were used to evaluate potential impacts:

- Amount of hazardous materials brought onto the installations that support the EELV program that could result in exposure to the environment or public through release or disposal practices
- Hazardous waste generation that may invoke additional regulatory requirements
- Pollution prevention practices to be used during the EELV program to minimize environmental impacts associated with launch operations
- EELV program activities that would affect IRP activities

4.6.1 Proposed Action

This section describes the hazardous materials and hazardous waste management impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems. The impacts of each of these portions of the Proposed Action are discussed separately, followed by an assessment of the combined impacts of the Proposed Action.

4.6.1.1 Cape Canaveral Air Force Station

A total of 430 launches would take place at CCAFS over the 20-year period under the Proposed Action. The peak-year launch total would be 26 (estimated to be 2004).

4.6.1.1.1 Atlas V System

Hazardous Materials Management. The types and quantities of hazardous materials used per launch would remain the same for the Atlas V system as for the No-Action Alternative. The types are quantified in Table 4.6-1. As stated in Section 2.1.3.1.1, the only change in the lift vehicle for the Atlas V system would be the addition of up to five SRMs to most of the Atlas V 500 launches. The hazardous materials that would be unique to the SRMs are listed in Table 4.6-2. There would be a slight increase in the estimated annual number of launches as well. The Atlas V system with SRMs uses a solid fuel, identical to the propellants proposed for Concept B in the 1998 FEIS, which includes NH_4ClO_4, Al, and HTPB. The quantities of

propellant for Atlas V system vehicle components are listed in Table 2.1-3. As a result of the use of only cryogenic upper stages (CUSs) for the EELV program, A-50, MMH and N_2O_4, originally considered in the 1998 FEIS, are no longer used in either the Proposed Action or in the No-Action Alternative.

TABLE 4.6-1
Estimated Hazardous Materials Used Per Launch (all processes), Atlas V System[a]

Material	Quantity (lbs)		
	300/400	500[b]	Heavy
POL	4,790	4,790	9,580
VOC-Based Primers, Topcoats, and Coatings	320	320	640
NonVOC-Based Primers, Topcoats, and Coatings	190	190	320
VOC-Based Solvents and Cleaners	1,380	1,380	2,750
NonVOC-Based Solvents and Cleaners	950	950	1,900
Corrosives	5,500	5,500	5,500
Refrigerants	0	0	0
Adhesives, Sealants, and Epoxies	2,280	2,280	4,570
Other	440	640	870
Total	15,850	16,050	26,130

[a]Table does not include propellants.
[b]Atlas 500 lift vehicle requires SRMs.
lbs = pounds.
POL = petroleum, oil, and lubricants.
VOC = volatile organic compounds.

TABLE 4.6-2
Estimated Hazardous Materials Utilized Per SRM, Atlas V System

Material	Quantity	Unit
Electron QED Solvent	1	quart
MIL-P-23377 Epoxy Primer	1	pint
Silicone RTV 88, Curing Agent, and Primer	2	gallons
Electrical-Insulating Enamel	1	ounces
Acrylic Primer	1	gallons
Conductive Paint	2	gallons
Chemical Conversion Coating	2	ounces
Cork Potting Compound	1	quart
Epoxy Resin Adhesive	1	quart

Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action are quantified in Table 4.6-3. Implementation of the

Proposed Action would increase the amount of hazardous materials used on CCAFS by an average of approximately 35,100 pounds per year over the 20-year period. This increase in hazardous material use is primarily the result of the estimated increase in the number of Atlas V system launches for the Proposed Action at CCAFS.

TABLE 4.6-3
Total Estimated Hazardous Materials Used for the Proposed Action and the No-Action Alternative for Atlas V System, 2001-2020, CCAFS[a]

Lift Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used (lbs)
EELV Proposed Action[b]			3,477,580 (1,738.8 tons)
Atlas V-300/400	19	15,850	
Atlas V-500 [c]	180	16,050	
Atlas V-Heavy	11	26,130	
EELV No-Action Alternative[b]			2,775,880 (1,387.9 tons)
Atlas V-300/400	157	15,850	
Atlas V-Heavy	11	26,130	

[a]Table does not include propellants.
[b]Data provided by contractor.
[c]Includes additional 200 lbs estimated for SRM-related hazardous materials.
EELV = Evolved Expendable Launch Vehicle.
lbs = pounds.
SRM = solid rocket motor.

Although launch rates would increase, minimal processing would occur onsite. Similar to the Proposed Action in the 1998 FEIS, lift vehicle components would be received at CCAFS in flightworthy condition. Payload fairings would arrive cleaned, bagged, and ready for processing. No cleaning of payload fairings would occur onsite. The Proposed Action would be a "ship-and-shoot" operation; the SRMs would be assembled and loaded with propellant by the manufacturer, shipped to the launch site, attached to the lift vehicle, and launched.

The SRMs would be received at SLC-41 and staged there for a short period (typically 1 or 2 days) in transport trailers. Alternatively, the SRMs could be staged at SLC-11 for longer durations (typically no longer than 4 weeks) in transport trailers if launches were delayed at SLC-41 for any reason. No handling of hazardous materials associated with the SRMs would be necessary as a result of the Proposed Action.

If any rework of the SRMs were required on-station, less than 200 pounds of hazardous materials would be required per launch. The materials would include xylenes, methyl ethyl ketone (MEK), ablatives (cork), lubricants, paints, oils, and solvents. The maintenance work and storage of materials would occur on transport trucks staged on the launch pad deck. All permits would be obtained to comply with federal, state, and local regulations. Management, use, and storage of hazardous materials would be consistent with the 1998 FEIS. The LVCs would conduct all activities in accordance with existing regulations for

the use and storage of hazardous materials. No changes in hazardous material management procedures or requirements would be expected with the introduction of SRMs.

CCAFS has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid and solid propellants. The amount of liquid propellants stored on the installation would increase as a result of the increased number of launches. As indicated above, solid propellant would be present at the site for a few days before each launch. The SRM propellant has the consistency of a pencil eraser. Launch personnel would not be in contact with the actual solid propellant.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials and fuels.

Hazardous Waste Management. The types and quantities of hazardous waste generated per launch would remain the same for the Atlas V system with SRMs as for the No-Action Alternative. These types are quantified in Table 4.6-4. If any rework of the SRMs were required on-station, it is expected that less than 200 pounds of hazardous waste would be generated per launch. The materials would include xylenes, MEK, ablatives (cork), lubricants, paints, oils, and solvents. If NDE testing were performed, less than 2,000 gallons of photoprocessing wastewater would be generated. If batteries were required, small amounts of silver/zinc, alkaline, lead acid, and lithium battery waste would be generated.

Table 4.6-5 provides estimates of the total quantities of hazardous waste that would be generated by the Proposed Action. Implementation of the Proposed Action would increase the amount of hazardous waste generated by the Atlas V system program at CCAFS by an average of approximately 23,200 pounds per year over the 20-year period. This increase in hazardous waste is primarily a result of the estimated increase in the number of Atlas V system launches for the Proposed Action at CCAFS.

TABLE 4.6-4
Estimated Hazardous Waste Generated Per Launch, Atlas V System[a]

Characteristic RCRA Wastes	Quantity (lbs) 300/400	Quantity (lbs) 500	Quantity (lbs) Heavy
Ignitable D001 RCRA Wastes	980	980	1,340
Halogenated Solvents F001/F002 RCRA Wastes	0	0	0
Characteristic RCRA Wastes	40	40	110
Corrosive D002 RCRA Waste	5,500	5,500	5,500
Commercial Chemical Products (U) RCRA Wastes	3,100	3,100	3,100
Acutely Hazardous Waste (P) RCRA Wastes	0	0	0
Reactive D003 RCRA Wastes	500	500	500
State-Regulated Wastes	0	0	0
Miscellaneous Wastes	50	250	50
Total	10,170	10,370	10,600

[a]Data provided by contractor.
EPA = U.S. Environmental Protection Agency.
lbs = pounds.
RCRA = Resource Conservation and Recovery Act.

TABLE 4.6-5
Total Estimated Hazardous Waste Generated for the Proposed Action and the No-Action Alternative for Atlas V System, 2001-2020, CCAFS[a]

Lift Vehicle System	Number of Launches	Hazardous Waste Produced (lbs/launch)	Total Hazardous Waste Produced (lbs)
EELV Proposed Action[b]			2,176,430 (1,088.2 tons)
Atlas V-300/400	19	10,170	
Atlas V-500 [c]	180	10,370	
Atlas V-Heavy	11	10,600	
EELV No-Action Alternative[b]			1,713,290 (856.6 tons)
Atlas V-300/400	157	10,170	
Atlas V-Heavy	11	10,600	

[a]Table does not include propellants.
[b]Data provided by contractor.
[c]Includes additional 200 lbs estimated for SRM-related hazardous waste.
EELV = Evolved Expendable Launch Vehicle.
lbs = pounds.
SRM = solid rocket motor.

The launch contractor will have the mechanisms in place to store, manage, and properly ship hazardous waste offsite for disposal, including propellant waste. Hazardous waste would be stored up to 90 days at the Missile Inert Storage (MIS) facility (Building 75285), and at a designated location at the VIF, on the air station. Recycling or disposal of hazardous waste will be in accordance with federal, state, and local regulations at an approved recycling facility or offsite permitted TSDF.

The contractor will be directly responsible for disposing of hazardous wastes, ensuring that the management and disposal of all hazardous wastes would be conducted in accordance with all applicable federal, state, and local regulations. Because wastes from the Proposed Action would be similar to wastes currently handled by CCAFS, no adverse impacts are anticipated.

Pollution Prevention. No Class I ODS would be used for any of the Proposed Action activities at CCAFS. Shipping components to the launch site in flightworthy condition and minimizing prelaunch processing would reduce pollution at the site. A stated objective for the EELV program is to seek opportunities to eliminate or minimize use of hazardous materials throughout the lifecycle of the program. As required under the contract, the contractors have developed a Hazardous Materials Management Report to outline strategies to minimize the use of Class II ODSs and EPCRA 313 chemicals. This plan is to be applied throughout the design of each lift vehicle, incorporating trade studies and emphasizing reduction of hazardous materials to be used on government installations. Current projections of hazardous material usage do not yet reflect the results of all pollution prevention efforts, which will continue to mature throughout the development of each system. These efforts would represent no change from the current scenario in the No-Action Alternative.

Installation Restoration Program. Current IRP activities are described in Section 3.6.2.4. Remedial activities at CCAFS would be conducted by IRP personnel, or their representative, and coördinated with EELV personnel to minimize impacts to EELV program activities. There would be no change from the No-Action Alternative because no new ground-disturbing EELV program facility construction is planned under the Proposed Action that would affect IRP activities.

The LVC will be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances. This would reduce the potential for impacts; therefore, no mitigation measures would be required.

4.6.1.1.2 Delta IV System

Hazardous Materials Management. The types and quantities of hazardous materials used per launch would remain the same for the Delta IV system with larger SRMs as for the No-Action Alternative, except for the materials used for the larger SRMs. These types are quantified in Table 4.6-6. The hazardous materials that would be unique to the SRMs are listed in Table 4.6-7. As stated in Section 2.1.3.2.1, the only change in the lift vehicle for the Delta IV system with larger SRMs would be the substitution of the GEM-46 SRMs analyzed in the 1998 FEIS with GEM-60 SRMs that are approximately 76 percent heavier in propellant weight. There would be an increase in the annual number of launches as well. The Delta IV system with larger SRMs would use a solid propellant, identical to the propellants proposed in the 1998 FEIS, which includes NH_4ClO_4, Al, and HTPB. The quantities of propellant for Delta IV system vehicle components are listed in Table 2.1-7. Because of the use of only CUSs for EELV systems, A-50, MMH, and N_2O_4 (originally considered in the FEIS) are no longer used in either the Proposed Action or the No-Action Alternative.

TABLE 4.6-6
Estimated Hazardous Materials Used Per Launch (all processes), Delta IV System [a, b]

Material	Quantity (lbs) M	M+	H
POL	80	80	80
VOC-Based Primers, Topcoats, and Coatings	580	580	580
Non-VOC-Based Primers, Topcoats, and Coatings	460	460	460
VOC-Based Solvents and Cleaners	530	530	530
Non-VOC-Based Solvents and Cleaners	1,070	1,070	1,070
Corrosives	5,500	5,500	5,500
Refrigerants	0	0	0
Adhesives, Sealants, and Epoxies	690	690	690
Other	20	120	20
Total	8,930	9,030	8,930

[a]The table does not include propellants.
[b]Estimated quantities are rounded to the nearest pound and are the same for CCAFS and Vandenberg AFB. Estimates do not depend on vehicle type.
H = Heavy-lift vehicle.
lbs = pounds.
M = Medium-lift vehicle (MLV).
M+ = MLV with SRMs.
POL = petroleum, oil, and lubricants.
VOC = volatile organic compounds.

TABLE 4.6-7
Estimated Hazardous Materials Used Per SRM, Delta IV System[a]

Material	Quantity
Electron QED Solvent	1 quart
MIL-P-23377 Epoxy Primer	1 pint
Silicone RTV 88, Curing Agent, and Primer	2 gallons
Electrical-Insulating Enamel	1 ounce
Acrylic Primer	1 gallon
Conductive Paint	2 gallons
Chemical Conversion Coating	2 ounces
Cork Potting Compound	1 quart
Epoxy Resin Adhesive	1 quart

[a]Table does not include propellants.

Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action are quantified in Table 4.6-8. Implementation of the Proposed Action would increase the amount of hazardous materials used on CCAFS by an average of approximately 21,000 pounds per year over the 20-year period. This increase in hazardous material use is primarily the result of the estimated increased in the number of total Delta IV system launches for the Proposed Action at CCAFS.

TABLE 4.6-8
Total Estimated Hazardous Materials Used for the Proposed Action and the No-Action Alternative for Delta IV System, 2001-2020, CCAFS[a]

Lift Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used (lbs)
EELV Proposed Action[b]			1,982,800 (991.4 tons)
Delta IV-M+[c]	182	9,030	
Delta IV-M	25	8,930	
Delta IV-H	13	8,930	
EELV No-Action Alternative[b]			1,562,750 (781.4 tons)
Delta IV- M+ (GEM-46)	103	8,930	
Delta IV –M	59	8,930	
Delta IV-H	13	8,930	

[a]Table does not include propellants.
[b]Data provided by contractor.
[c]Includes additional 100 lbs estimated for larger SRM-related hazardous materials.
EELV = Evolved Expendable Launch Vehicle.
H = Heavy-lift vehicle.
lbs = pounds.
M = Medium-lift vehicle (MLV).
M+ = MLV with SRMs.

Although launch rates would increase, minimal processing would occur onsite. As described in Section 4.6.1.1.1 for the Atlas V system with SRMs, the Delta IV system with

larger SRMs lift vehicle components would be received at CCAFS in flightworthy condition. The Proposed Action would be "ship-and-shoot," as described in Section 4.6.1.1.1.

The SRMs would be received at the RIS (Building 70580) facility and staged there for several days prior to launch. Up to twelve SRMs could be stored at the RIS facility at CCAFS. No handling of hazardous materials associated with the SRMs would be necessary as a result of the Proposed Action.

Management, use, and storage of hazardous materials would be consistent with the 1998 FEIS. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials. No changes in hazardous material management procedures or requirements would be expected with the increase in size of the SRMs.

CCAFS has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid and solid propellants. The amount of liquid propellants stored at the installation would increase as a result of the estimated increase in the number of launches. As indicated above, SRMs containing solid propellant could be present at the site for a few days before each launch. Launch personnel would not be in contact with the actual solid propellant.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials and fuels.

Hazardous Waste Management. The types and quantities of hazardous waste generated per launch would remain the same for the Delta IV system with larger SRMs as for the No-Action Alternative, except for the waste generated from the materials used for the SRMs (Table 4.6-7). These types are quantified in Table 4.6-9.

TABLE 4.6-9
Estimated Hazardous Waste Generated Per Launch, Delta IV System[a]

	Quantity (lbs)		
Hazardous Waste Generated Per Launch	**M**	**M+**	**H**
Ignitable D001 RCRA Wastes	3,570	3,570	3,570
Halogenated Solvents F001/F002 RCRA Wastes	0	0	0
Non-Halogenated Solvents F003/F004/F005 RCRA	890	890	890
Corrosive D002 RCRA Wastes	5,500	5,500	5,500
Toxic D004-D0012 RCRA Wastes	1,700	1,700	1,700
Commercial Chemical Products (U) RCRA Wastes	430	430	430
Acutely Hazardous Waste (P) RCRA Wastes	0	0	0
Reactive D003 RCRA Wastes	20	20	20
Miscellaneous Wastes	4,340	4,440	4,340
Total	16,450	16,550	16,450

[a] Data provided by contractor.
lbs = pounds.
RCRA = Resource Conservation and Recovery Act.

Table 4.6-10 provides estimates of the total quantities of hazardous waste that would be generated by the Proposed Action. Implementation of the Proposed Action would increase the amount of hazardous waste generated by the Delta IV system with larger SRMs program at CCAFS by an average of approximately 37,900 pounds per year over the 20-year period. This increase in hazardous waste is a result of the estimated increase in the total number of Delta IV system launches for the Proposed Action at CCAFS.

The LVC will have the mechanisms in place to store, manage, and dispose of hazardous waste, including propellant waste. Hazardous waste would be stored in Building 38316. Recycling or disposal of hazardous waste would be in accordance with local, state, and federal regulations at an approved recycling facility or offsite permitted TSDF, respectively.

TABLE 4.6-10
Total Estimated Hazardous Waste Generated for the Proposed Action and the No-Action Alternative for Delta IV System, 2001-2020, CCAFS[a]

Lift Vehicle System	Number of Launches	Hazardous Waste Produced (lbs/launch)[b]	Total Hazardous Waste Produced (lbs)
EELV Proposed Action[c]			3,637,200 (1,818.6 tons)
Delta IV-M+[d]	182	16,550	
Delta IV-M	25	16,450	
Delta IV-H	13	16,450	
EELV No-Action Alternative[c]			2,878,750 (1,439.4 tons)
Delta IV- M+	103	16,450	
Delta IV –M	59	16,450	
Delta IV-H	13	16,450	

[a]Table does not include propellants.
[b]Does not include Vandenberg AFB State-Regulated Waste in Table 4.6-8.
[c]Data provided by contractor.
[d]Includes additional 100 lbs estimated for larger SRM-related hazardous waste.
EELV = Evolved Expendable Launch Vehicle.
H = Heavy-lift vehicle.
lbs = pounds.
M = Medium-lift vehicle (MLV).
M+ = MLV with SRMs.

The contractor will be directly responsible for disposal of hazardous wastes, ensuring that the management and disposal of all hazardous wastes would be conducted in accordance with all applicable federal, state, and local regulations. Because wastes from the Proposed Action would be similar to wastes currently handled by CCAFS, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on CCAFS from activities of the Delta IV system with larger SRMs are the same as discussed for the Atlas V system with SRMs, Section 4.6.1.1.1, Pollution Prevention.

Installation Restoration Program. Current IRP activities are described in Section 3.6.2.4. Remedial activities at CCAFS would be conducted by IRP personnel, or their representative,

and coordinated with EELV personnel to minimize impacts to EELV program activities. There would be a minor change from the No-Action Alternative as a result of new ground-disturbing EELV program facility construction at the RIS facility. This construction would not affect IRP activities.

The LVC will be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances. This would reduce the potential for impacts; therefore, no mitigation measures would be required.

4.6.1.2 Vandenberg AFB

A total of 136 launches would take place at Vandenberg AFB over the 20-year period under the Proposed Action. The peak-year launch total would be 9 (estimated for 2007 and 2008).

4.6.1.2.1 Atlas V System

Hazardous Materials Management. The types of hazardous materials proposed for use for the Proposed Action Atlas V system activities at Vandenberg AFB would be the same as those materials proposed for the Atlas V system with SRMs program used at CCAFS, described in Section 4.6.1.1.1, Hazardous Materials Management. The Proposed Action would include an increase in the annual number of launches from the No-Action Alternative. Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action are quantified in Table 4.6-11.

TABLE 4.6-11
Total Estimated Hazardous Materials Used for the Proposed Action and the No-Action Alternative for Atlas V System, 2001-2020, Vandenberg AFB[a]

Lift Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used (lbs)
EELV Proposed Action[b]			1,149,880 (574.9 tons)
Atlas V-300/400	10	15,850	
Atlas V-500[c]	52	16,050	
Atlas V-Heavy	6	26,130	
EELV No-Action Alternative[b]			1,060,230 (530.1 tons)
Atlas V-300/400	57	15,850	
Atlas V-Heavy	6	26,130	

[a]Table does not include propellants
[b]Data provided by contractor
[c]Includes additional 200 lbs estimated for SRM-related hazardous materials
EELV = Evolved Expendable Launch Vehicle.
lbs = pounds.
SRM = solid rocket motor.

Implementation of the Proposed Action would increase the amount of hazardous materials used on Vandenberg AFB by an average of approximately 4,500 pounds per year over the 20-year period. This increase in hazardous material use would be primarily a result of the

increased number of estimated Atlas V system launches for the Proposed Action at Vandenberg AFB.

As at CCAFS, minimal processing would occur on the base. Similar to the Proposed Action in the 1998 FEIS, lift vehicle components would be received at Vandenberg AFB in flightworthy condition. Payload fairings would arrive cleaned, bagged, and ready for processing. No cleaning of payload fairings would occur onsite. The Proposed Action would be a "ship-and-shoot" operation; the SRMs would be assembled and loaded with propellant by the manufacturer, shipped to the launch site, attached to the lift vehicle, and launched.

The SRMs would be received at SLC-3W and staged there for a short period (typically 1 to 2 days) in transport trailers. Alternatively, the SRMs would be staged at Building 960 for several weeks in transport trailers if launches were delayed at SLC-3W for any reason. No handling of hazardous materials associated with the SRMs would be necessary as a result of the Proposed Action.

Any SRM rework, if required, would be performed in a similar manner using the same hazardous materials as at CCAFS (Section 4.6.1.1.1). Less than 200 pounds of hazardous materials would be required per launch. All permits would be obtained to comply with federal, state, and local regulations. Management, use, and storage of hazardous materials would be consistent with the 1998 FEIS. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials. No changes in hazardous material management procedures or requirements would be expected with the introduction of SRMs.

Vandenberg AFB has the mechanisms in place to store and manage the proposed hazardous materials, including liquid and solid propellants. The amount of liquid propellants stored at the installation would increase as a result of the increased number of launches. As indicated above, SRMs containing solid propellant would be present at the site for a few days before each launch. However, launch personnel would not come into contact with the actual solid propellant.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials and fuels.

Hazardous Waste Management. The types and quantities of hazardous waste generated under the Proposed Action would be similar to wastes generated by current lift vehicle systems (see Table 4.6-4). If any rework of the SRMs were required on-base, it is expected that less than 200 pounds of hazardous waste would be generated per launch. The types and quantities of waste would be the same as those for CCAFS for the Atlas V system with SRMs (Section 4.6.1.1.1, Hazardous Waste Management).

Table 4.6-12 provides estimates of the total quantities of hazardous waste that would be generated by the Proposed Action. Implementation of the Proposed Action would increase the amount of hazardous waste generated by the Atlas V system with SRMs program at Vandenberg AFB by an average of approximately 3,100 pounds per year over the 20-year period. This increase in hazardous waste is primarily a result of the increased number of estimated Atlas V system launches for the Proposed Action at Vandenberg AFB.

Vandenberg AFB has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous wastes would be stored up to 90 days at SLC-3W. Recycling or disposal of hazardous waste would be in accordance with federal, state, and local regulations at an approved recycling facility or offsite permitted landfill, respectively.

The VLC would be directly responsible for disposal of hazardous wastes, ensuring that the management and disposal of all hazardous wastes would be conducted in accordance with all applicable federal, state, and local regulations. Because wastes from the Proposed Action would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

TABLE 4.6-12
Total Hazardous Waste Generated for the Proposed Action and the No-Action Alternative for Atlas V System, 2001-2020, Vandenberg AFB[a]

Lift Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used (lbs)
EELV Proposed Action[b]			704,040 (352.3 tons)
Atlas V-300/400	10	10,170	
Atlas V-500[c]	52	10,370	
Atlas V-Heavy	6	10,600	
EELV No-Action Alternative[b]			643,290 (321.6 tons)
Atlas V-300/400	57	10,170	
Atlas V-Heavy	6	10,600	

[a]Table does not include propellants.
[b]Data provided by contractor.
[c]Includes additional 200 lbs estimated for SRM-related hazardous materials
EELV = Evolved Expendable Launch Vehicle.
lbs = pounds.
SRM = solid rocket motor.

Pollution Prevention. Pollution prevention impacts would be the same as those discussed for CCAFS in Section 4.6.1.1.1, Pollution Prevention.

Installation Restoration Program. Current IRP activities are described in Section 3.6.3.4. No new ground-disturbing construction is planned for the Proposed Action at Vandenberg AFB, so no changes from the No-Action Alternative would be expected for any IRP investigations resulting from EELV program activities. Remedial activities would be conducted by IRP personnel, or their representative, and coordinated with EELV personnel to minimize impacts to EELV program activities.

The LVC would be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures would be required.

4.6.1.2.2 Delta IV System

Hazardous Materials Management. The types and quantities of hazardous materials used per launch would remain the same for the Proposed Action for the Delta IV system, as described in Section 4.6.1.1.2. There would be an estimated increase in the annual number of launches of the Delta IV system with larger SRMs at Vandenberg AFB.

Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action are quantified in Table 4.6-13. Implementation of the Proposed Action would increase the amount of hazardous materials used on Vandenberg AFB by an average of approximately 1,200 pounds per year over the 20-year period. This increase in hazardous material use results from the estimated increase in the number of launches proposed for the Delta IV system at Vandenberg AFB.

TABLE 4.6-13
Total Hazardous Materials Used for the Proposed Action and the No-Action Alternative for Delta IV System, 2001-2020, Vandenberg AFB[a]

Lift Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used (lbs)
EELV Proposed Action [b]			612,640 (306.3 tons)
Delta IV-M+ [c]	54	9,030	
Delta IV-M	8	8,930	
Delta IV-H	6	8,930	
EELV No-Action Alternative[c]			589,380 (294.7 tons)
Delta IV- M+	50	8,930	
Delta IV –M	10	8,930	
Delta IV-H	6	8,930	

[a]Table does not include propellants.
[b]Data provided by contractor.
[c]Includes additional 100 lbs estimated for SRM-related hazardous materials.
EELV = Evolved Expendable Launch Vehicle.
HLV = Heavy-lift vehicle.
lbs = pounds.
M = Medium-lift vehicle (MLV).
M+ = MLV with SRMs.

Although launch rates would increase, minimal processing would occur onsite. As described in Section 4.6.1.1.1 for the Atlas V system with SRMs, the Delta IV system with larger SRMs lift vehicle components would be received at Vandenberg in flightworthy condition. The Proposed Action would be "ship-and-shoot," as described in Section 4.6.1.1.1.

The SRMs would be received at Building 945 and staged there for several days prior to launch. Up to one ship-set (4) of the SRMs could be stored at Vandenberg AFB. No handling of hazardous materials associated with the SRMs would be necessary as a result of the Proposed Action.

Management, use, and storage of hazardous materials at Vandenberg AFB would be conducted as described in Section 4.6.1.2.1, Hazardous Materials Management. The amount

of liquid propellants stored on the installation would increase as a result of the estimated increase in the number of launches. As indicated above, SRMs containing solid propellant would be present at the site for a few days before each launch. Launch personnel would not be in contact with the actual solid propellant. No changes in hazardous material management procedures or requirements would be expected with the increase in size of SRMs.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types and quantities of hazardous waste generated would be the same as those discussed in Section 4.6.1.1.2, Hazardous Waste Management. Table 4.6-14 provides estimates of the total quantities of hazardous waste that would be generated by the Proposed Action. Implementation of the Proposed Action would increase the amount of hazardous waste generated by the Delta IV system program at Vandenberg AFB by an average of approximately 1,900 pounds per year over the 20-year period. This increase in hazardous waste is primarily a result of the increased total number of Delta IV launches for the Proposed Action at Vandenberg AFB.

TABLE 4.6-14
Total Estimated Hazardous Waste Generated for the Proposed Action and the No-Action Alternative for Delta IV System, 2001-2020, Vandenberg AFB[a]

Lift Vehicle System	Number of Launches	Hazardous Waste Produced (lbs/launch)[b]	Total Hazardous Waste Produced (lbs)
EELV Proposed Action Alternative[b,c]			1,124,000 (562.0 tons)
Delta IV-M+[d]	54	16,550	
Delta IV-M	8	16,450	
Delta IV-H	6	16,450	
EELV No-Action Alternative[b,c]			1,085,700 (542.9 tons)
Delta IV- M+ (GEM-46)	50	16,450	
Delta IV –M	10	16,450	
Delta IV-H	6	16,450	

[a]Table does not include propellants.
[b]Includes Vandenberg AFB State-Regulated Waste in Table 4.6-8.
[c]Data provided by contractor.
[d]Includes additional 100 lbs estimated for SRM-related hazardous materials.
EELV = Evolved Expendable Launch Vehicle.
H = Heavy-lift vehicle.
lbs = pounds.
M = Medium-lift vehicle (MLV).
M+ = MLV with SRMs.
SRMs = solid rocket motors.

Vandenberg AFB has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous waste would be stored in Buildings 342. Recycling or disposal of hazardous waste will be in accordance with federal, state, and local regulations at an approved recycling facility or offsite permitted landfill, respectively.

The contractor will be directly responsible for disposal of hazardous wastes, ensuring that the management and disposal of all hazardous wastes would be conducted in accordance with all applicable federal, state, and local regulations. Because wastes from the Proposed Action would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts would be the same as those discussed for CCAFS in Section 4.6.1.1.1, Pollution Prevention.

Installation Restoration Program. Current IRP activities are described in Section 3.6.3.4. Remedial activities at Vandenberg AFB would be conducted by IRP personnel, or their representative, and coordinated with EELV personnel to minimize impacts to EELV program activities. There would be no change from the No-Action Alternative, because no new ground-disturbing EELV program facility construction is planned under the Proposed Action that would affect IRP activities.

The LVC would be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures would be required.

4.6.1.3 Combined Impacts of the Proposed Action

This section describes the combined impacts on hazardous materials and hazardous waste management from implementing both elements that make up the Proposed Action (SRMs on Atlas V system with SRMs and Delta IV system with larger SRMs at CCAFS and Vandenberg AFB).

4.6.1.3.1 Cape Canaveral Air Force Station

Hazardous Materials Management. The types of hazardous materials proposed for use in activities of the combined Atlas V system with SRMs and Delta IV system with larger SRMs would be similar to those used at CCAFS for the No-Action Alternative, as discussed in Sections 4.6.1.1.1 and 4.6.1.1.2. Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action for each vehicle program are quantified in Tables 4.6-3 and 4.6-8. Implementation of the Proposed Action would increase the amount of hazardous materials used at CCAFS by an average of approximately 56,100 pounds per year over the 20-year period. This increase in hazardous material use is a result of the estimated increase in the total number of both Atlas V system and Delta IV system launches for the Proposed Action at CCAFS.

Other hazardous materials management impacts from the Proposed Action are discussed in Sections 4.6.1.1.1 and 4.6.1.1.2. No changes in hazardous material management procedures or requirements would be expected with the addition of SRMs to the Atlas V system vehicles and the increase in size of SRMs on the Delta IV system vehicles.

Hazardous Waste Management. The types and quantities of hazardous waste generated for the combined Atlas V system with SRMs and Delta IV system with larger SRMs activities would be similar to those used at CCAFS for the No-Action Alternative, as discussed in Sections 4.6.1.1.1 and 4.6.1.1.2. Estimates of the total number of launches and total weight of hazardous waste that would be generated by the Proposed Action for each vehicle program are

quantified in Tables 4.6-5 and 4.6-10. Implementation of the Proposed Action would increase the amount of hazardous waste generated at CCAFS by an average of approximately 61,100 pounds per year over the 20-year period. This increase in hazardous waste is primarily a result of the estimated increase in the total number of both Atlas V system and Delta IV system launches for the Proposed Action at CCAFS.

Other hazardous waste management impacts from the Proposed Action are discussed in Sections 4.6.1.1.1 and 4.6.1.1.2. Because wastes from the Proposed Action would be similar to wastes currently handled by CCAFS, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts would be the same as those discussed for CCAFS in Sections 4.6.1.1.1 and 4.6.1.1.2.

Installation Restoration Program. As indicated in Section 4.6.1.1.2, there would be a minor change from the No-Action Alternative at CCAFS because of new ground-disturbing EELV program facility construction at the Delta IV RIS facility. This construction would not affect IRP activities. The lift vehicle contractor will be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures would be required.

4.6.1.3.2 Vandenberg AFB

Hazardous Materials Management. The types of hazardous materials proposed for use for combined Atlas V system and Delta IV system activities would be similar to those used at Vandenberg AFB for the No-Action Alternative, as discussed in Sections 4.6.1.2.1 and 4.6.1.2.2. Estimates of the total number of launches and total weight of hazardous materials that would be used for the Proposed Action for each vehicle program are quantified in Tables 4.6-11 and 4.6-13. Implementation of the Proposed Action would increase the total amount of hazardous materials used on Vandenberg AFB by an average of approximately 5,700 pounds per year over the 20-year period. This increase in hazardous materials use is primarily a result of the estimated increase in the total number of both the Atlas V system with SRMs and the Delta IV system with larger SRMs launches for the Proposed Action at Vandenberg AFB.

Other hazardous materials management impacts from the Proposed Action are discussed in Sections 4.6.1.2.1 and 4.6.1.2.2. No changes in hazardous material management procedures or requirements would be expected with the addition of SRMs to the Atlas V system vehicles and given the increase in size of SRMs on the Delta IV system vehicles.

Hazardous Waste Management. The types and quantities of hazardous waste generated for the combined Atlas V system with SRMs and Delta IV system with larger SRMs activities would be similar to those used at Vandenberg AFB for the No-Action Alternative, as discussed in Sections 4.6.1.2.1 and 4.6.1.2.2. Estimates of the total number of launches and total weight of hazardous waste that would be generated by the Proposed Action for each vehicle program are quantified in Tables 4.6-12 and 4.6-14. Implementation of the Proposed Action would increase the amount of hazardous waste generated at Vandenberg AFB by an average of approximately 5,000 pounds per year over the 20-year period. This increase in hazardous waste is primarily the result of the estimated increase in the total number of both

the Atlas V system and Delta IV system launches for the Proposed Action at Vandenberg AFB.

Other hazardous waste management impacts from the Proposed Action are discussed in Sections 4.6.1.2.1 and 4.6.1.2.2. Because wastes from the Proposed Action would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts would be the same as those discussed for Vandenberg AFB in Sections 4.6.1.2.1 and 4.6.1.2.2.

Installation Restoration Program. No new ground-disturbing construction is planned for the Proposed Action at Vandenberg AFB. Therefore, no changes from the No-Action Alternative would be expected for any IRP investigations from EELV program activities. The LVC would be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures would be required.

4.6.1.4 Cumulative Impacts

This section discusses impacts of other programs in the project vicinity that, when considered with the impacts of the Proposed Action, would result in cumulative impacts.

4.6.1.4.1 Cape Canaveral Air Force Station

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, there would be no cumulative impacts to the hazardous materials and waste management programs from the proposed use of SRMs in the EELV programs at CCAFS.

4.6.1.4.2 Vandenberg AFB

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, there would be no cumulative impacts to the hazardous materials and waste management programs from implementing the Proposed Action as a result of the proposed use of SRMs in the EELV programs at Vandenberg AFB.

4.6.2 No-Action Alternative

This section summarizes the impact of the No-Action Alternative on hazardous materials and hazardous waste management using information described in the 1998 FEIS.

4.6.2.1 Cape Canaveral Air Force Station

Under the No-Action Alternative, only the construction proposed in the 1998 FEIS would be performed. A total of 343 launches will take place at CCAFS over the 20-year period. The peak-year launch total will be 21 (estimated in 2013 and 2015). Expected impacts and amounts of hazardous materials and hazardous waste resulting from the No-Action Alternative are discussed in Sections 4.6.1.1.1 and 4.6.1.2.1 in the 1998 FEIS and are summarized briefly below.

Hazardous Materials Management. The types and quantities of hazardous materials used per launch for the No-Action Alternative will be the same as for the Proposed Action for the Atlas V system and the Delta IV system (Concepts A and B, respectively, in the 1998 FEIS). These types are quantified in Tables 4.6-1 and 4.6-6. No SRMs will be used for the Atlas V system and the smaller SRMs (GEM-46) will be used for the Delta IV system. The quantities of propellant (minus the SRMs highlighted in gray) for Atlas V and Delta IV system vehicle components are listed in Tables 2.1-3 and 2.1-7, respectively. The smaller SRMs for the Delta IV M+ vehicles in the No-Action alternative will require the following propellant quantities: 25,000 lbs of NH_4ClO_4, 7,000 pounds of aluminum, and 5,000 lbs of HTPB. Given the use of only CUSs for EELV systems, A-50, MMH and N_2O_4, originally considered in the 1998 FEIS, will not be used in the No-Action Alternative. Estimates of the total number of launches and total weight of hazardous materials that will be used for the No-Action Alternative for each vehicle program at CCAFS are quantified in Tables 4.6-3 and 4.6-8.

CCAFS has the mechanisms in place to store and manage the quantity of hazardous materials under the No-Action Alternative, including liquid and solid propellants. Minimal processing of hazardous materials will occur onsite. Lift vehicle components will be received at CCAFS in flightworthy condition. Payload fairings will arrive cleaned, bagged, and ready for processing. No cleaning of payload fairings will occur onsite.

Hazardous Waste Management. The types and quantities of hazardous waste generated per launch will be the same as for the Proposed Action for Atlas V system and Delta IV system. These types are quantified in Tables 4.6-4 and 4.6-9. Tables 4.6-5 and 4.6-10 provide estimates of the total quantities of hazardous waste that will be generated by the No-Action Alternative at CCAFS.

The LVC will have the mechanisms in place to store, manage, and properly ship hazardous waste offsite for disposal, including propellant waste. Hazardous waste would be stored up to 90 days at the MIS facility, and at a designated location at the VIF, on the air station. Recycling or disposal of hazardous waste will be in accordance with local, state, and federal regulations at an approved recycling facility or offsite permitted landfill, respectively. Because wastes from the No-Action Alternative will be similar to wastes currently handled by CCAFS, no adverse impacts are anticipated.

Pollution Prevention. No Class I ODS would be used for any of the No-Action Alternative activities at CCAFS. As required under the contract, the contractors have developed a Hazardous Materials Management Report to outline strategies to minimize the use of Class II ODS and EPCRA 313 chemicals. These prevention efforts are outlined in Section 4.6.1.1.1, Pollution Prevention, for the Proposed Action.

Installation Restoration Program. Current IRP activities are described in Section 3.6.2.4. Any remedial activities at CCAFS will be coordinated through IRP personnel to minimize impacts to remediation activities and EELV program activities. The LVC will be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures would be required.

4.6.2.2 Vandenberg AFB

Under the No-Action Alternative, no new construction or facility modification will occur. Only the construction proposed in the 1998 FEIS will be performed. A total of 129 launches will take place at Vandenberg AFB over the 20-year period. The peak-year launch total will be 9 (estimated for 2007 and 2008). Expected impacts and amounts of hazardous materials and hazardous waste resulting from the No-Action Alternative are discussed in Sections 4.6.1.1.2 and 4.6.1.2.2 in the 1998 FEIS and are reviewed briefly below.

Hazardous Materials Management. The types and quantities of hazardous materials used per launch for the No-Action Alternative will be the same as for the Proposed Action for the Atlas V system with SRMs and the Delta IV system with larger SRMs. These types are quantified in Tables 4.6-1 and 4.6-6. No SRMs will be used for the Atlas V system, and the smaller SRMs described in the 1998 FEIS would be used for the Delta IV system. The quantities of propellant for Atlas V and Delta IV system vehicle components are listed in Tables 2.1-4 and 2.1-7, respectively. The smaller SRMs for the Delta IV M+ vehicles in the No-Action alternative will require the following propellant quantities: 25,000 lbs. of NH_4ClO_4, 7,000 pounds of aluminum, and 5,000 lbs of HTPB. Because only CUSs will be used for EELV systems, A-50, MMH and N_2O_4, originally considered in the 1998 FEIS, will not be used in the No-Action Alternative. Estimates of the total number of launches and total weight of hazardous materials that will be used for the No-Action Alternative for each vehicle program at Vandenberg AFB are quantified in Tables 4.6-11 and 4.6-13.

Vandenberg AFB has the mechanisms in place to store and manage the quantity of hazardous materials under the No-Action Alternative, including liquid and solid propellants. Minimal processing of hazardous materials would occur onsite. Lift vehicle components would be received at Vandenberg AFB in flightworthy condition. Payload fairings would arrive cleaned, bagged, and ready for processing. No cleaning of payload fairings would occur onsite.

Hazardous Waste Management. The types and quantities of hazardous waste generated per launch would be the same as for the Proposed Action for Atlas V systems and Delta IV systems. These types are quantified in Tables 4.6-4 and 4.6-9. Tables 4.6-12 and 4.6-14 provide estimates of the total quantities of hazardous waste that would be generated by the No-Action Alternative at Vandenberg AFB.

Vandenberg AFB has the mechanisms in place to store, manage, and dispose of hazardous waste, including propellant waste. Recycling or disposal of hazardous waste will be in accordance with local, state, and federal regulations at an approved recycling facility or at an offsite permitted landfill, respectively. Because wastes from the No-Action Alternative will be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

Pollution Prevention. No Class I ODS would be used for any of the No-Action Alternative activities at CCAFS. As required under the contract, the contractors have developed a Hazardous Materials Management Report to outline strategies to minimize the use of Class II ODS and EPCRA 313 chemicals. These prevention efforts are the same as those outlined in Section 4.6.1.1.1, Pollution Prevention, for the Proposed Action.

Installation Restoration Program. Current IRP activities are described in Section 3.6.3.4. Any remedial activities at Vandenberg AFB will be coordinated through IRP personnel to minimize impacts to remediation activities and EELV program activities. The LVC will be responsible for compliance with all applicable federal, state, and local regulations regarding the use, storage, handling, and disposal of hazardous substances, thereby reducing the potential for impacts. As a result, no mitigation measures will be required.

4.7 Health and Safety

This section describes the environmental consequences of the Proposed Action (Section 4.7.1) and the No-Action Alternative (Section 4.7.2) on Health and Safety at CCAFS and Vandenberg AFB.

4.7.1 Proposed Action

This section describes the impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems. The Proposed Action components (Atlas V and Delta IV systems) are not anticipated to result in health and safety impacts, either separately or in combination.

At the Western Range and the Eastern Range, hydrogen chloride (HCl), nitrogen dioxide (NO_2), nitrogen tetroxide (N_2O_4), nitric acid (HNO_3), ammonia (NH_3), aluminum oxide (Al_2O_3), carbon monoxide (CO), and hydrazine (N_2H_4) byproducts may be produced from a nominal or a failed launch of current U.S. launch vehicles. During nominal launches, emissions of concern to human health and safety occur only from stages ignited at lower altitudes. In the event of a catastrophic failure, the emission of substances from the propellant in any of the launch vehicle stages and payload could occur.

For the Proposed Action, the most significant potential health hazard during a nominal launch would be the HCl emitted from the burning of solid propellant. Prior to any land based vehicle launched from either CCAFS (Eastern Range) or Vandenberg AFB (Western Range) the safety offices employ an air dispersion computer model, the Rocket Exhaust Effluent Diffusion Model (REEDM), to produce a deterministic predicted toxic plume plot. This deterministic run is part of the data used by the risk management model, the Launch Area Toxic Risk Analysis (LATRA) model, to produce a probabilistic output in terms of expected causalities (E_C) and compared against existing Eastern and Western Range toxic Launch Commit Criteria (LCC). Range Safety offices on both ranges have developed a risk management approach designed to maintain E_C less than or equal to 30×10^{-6} with an individual risk of 1×10^{-6} over the varying population densities, while taking into account concentration, location, dwell time, and emergency preparedness procedures. Acceptable levels of risk have been derived from DOD implementation policies associated with Public Law 60 that established the Eastern and Western Ranges.

Exposure criteria of concern for the EELV program will need to focus on standards for hydrocarbon fuels and associated gaseous and particulate combustion products and volatile organic compounds emitted from burning advanced composite materials. Environmental, safety, and health assessments can utilize the tiered protocols. RP-1 (kerosene, fuel, rocket propellants –1) related tier levels are being refined for consideration of particulate matter

(total mass and respirable mass), polyaromatic hydrocarbons, and volatile organic compounds. Although there are no HQ AFSPC/SG recommended criteria for aluminum oxide (Al_2O_3), carbon monoxide (CO), ammonia (NH_3), or hydrotreated kerosene (RP-1), other applicable recommended standards have been established. The Federal Occupational Safety and Health Administration (OSHA) recommends an 8-hour Threshold Limit Value (TLV) for aluminum metal and Al_2O_3 of 15 mg/m^3 (total dust), and 5 mg/m^3 (respirable fraction) while California OSHA recommends 10 mg/m^3 (total dust) and 5 mg/m^3 (respirable fraction). The National Institute for Occupational Safety and Health (NIOSH) has recommended a short-term exposure limit (STEL) (15 minutes) of 35 ppm for NH_3. NIOSH has also established an 8-hour time-weighted average (TWA) Recommended Exposure Limit (REL) of 35 ppm for CO. Napthalene, an ingredient of RP-1 per the commodity's Material Safety Data Sheet (MSDS), has a NIOSH-recommended TWA of 10 ppm, a STEL of 15 ppm, and an IDLH value of 250 ppm. OSHA recommends a TLV of 10 ppm for Napthalene.

4.7.1.1 Cape Canaveral Air Force Station

4.7.1.1.1 Atlas V System

This section discusses the effects on Health and Safety at CCAFS from the addition of SRMs to the Atlas V system.

Regional Safety. CCAFS regional safety programs and emergency response procedures for the Proposed Action Atlas V launch operations would be the same as those described in Section 3.7.2.1 of the 1998 FEIS.

A System Safety Program Plan (SSPP) would be prepared prior to launch activities for the Proposed Action to identify and evaluate potential hazards, and to reduce associated risks to a level acceptable to Range Safety. Impact debris corridors would be updated to provide specific parameters as a result of vehicle and payload configurations for the Proposed Action.

Hazardous materials, such as propellants and associated ordnance, would be transported in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199) to ensure that the shipment would not catch fire, explode, or release toxic materials. Solid propellant would be loaded into the motor case at the manufacturing site. The SRMs would be transported via truck to the launch site at CCAFS. Trucks would have extra-long beds that could accommodate loads greater than 60 feet in length. Each truck would carry one SRM. The trucks would follow routes approved by federal and state DOTs and would adhere to all applicable federal and state highway transport safety measures. Other propellants and components would be shipped as specified in Section 3.7.2.1 of the 1998 FEIS.

Impact Debris Corridors. Representative launch trajectories were provided by LMC for launches of the Atlas V with SRMs at CCAFS and are included in Appendix Q. The trajectories shown are not binding cases. A detailed description of how impact locations were calculated is presented in Appendix Q.

Several figures in Appendix Q show where jettisoned spent SRMs are predicted to impact the Atlantic Ocean after launches of Atlas V vehicles. Launches are designed so that jettisoned bodies fall into pre-approved drop zones (ellipses), as shown in the figures.

Debris footprints are also presented in the event of a launch failure for various time periods (e.g., T+ 30 seconds) following launches, for mean annual wind profiles.

Trajectories are created and modified to ensure safety on the ground and at sea. Notice is given to Airmen and Mariners prior to launch. The underlying areas at risk from falling debris or jettisoned stages are cleared until all launch operations are completed. These scenarios represent no change from the No-Action Alternative, except for the addition of SRM drop zones.

The SW Safety Offices for the Eastern Range adhere to an approval process for each lift vehicle and mission to ensure that the risks associated with lift vehicle operations do not exceed acceptable limits.

On-Station Safety. On-station safety programs for Atlas V system with SRMs launch operations would be the same as on-station safety programs for the current launch operations, described in Section 3.7.2.2 of the 1998 FEIS, unless otherwise noted herein.

SRM-augmented Atlas V normal launches would generate NO_x, HCl, Al_2O_3, and CO. Ammonia would be generated from the RCS of the upper stage during a launch mishap. Dispersion of launch emissions would be predicted using the Rocket Exhaust Effluent Diffusing Model (REEDM) prior to a launch to determine a toxic hazard control (THC). The THC exposure concentrations for air contaminants would be compared to local risk management models and launch commit decision criteria. As a result of the comparison and risk estimation, emergency response preparations would be provided as described in Section 3.7.2.2 of the 1998 FEIS. No launch would occur if undue hazard existed for persons and property.

A summary of predicted ambient air concentrations for the above compounds is presented in Section 4.10.1.1.1, Atlas V System with SRMs. To assess air quality impacts during normal launches and launch failures, the analysis focused on the Atlas V-551/552 that would use five strap-on SRMs. The analysis also considered four meteorological cases (CCAFS1, CCAFS2, CCAFS3, and CCAFS4) at CCAFS. The REEDM-predicted concentrations used in this SEIS are screening concentrations only. Other conditions, such as weather assessed prior to actual launches, would result in predicted concentrations somewhat different from these values. For this analysis, it is conservatively assumed that all NO would be converted to NO_2. Table 4.7-1 compares predicted peak ground-level concentrations from a normal launch and launch failure to Air Force Space Command/Surgeon General (AFSPC/SG) endorsed exposure criteria, Occupational Safety and Health Administration (OSHA) standards, and National Institute of Safety and Health (NIOSH) standards. No predicted concentrations for the meteorological cases of normal launches evaluated exceed the respective exposure criteria; therefore, no health or safety impacts would be expected given the airborne chemicals emitted from the SRMs.

As shown in Table 4.7-1, the predicted HCl concentration for meteorological case CCAFS4 would exceed the exposure criteria for some launch failure scenarios (see Appendix T for details). As discussed in Section 3.7, however, launch decisions are not based directly on REEDM predictions, but rather on the results of probabilistic risk predictions. Thus, depending on the details of a launch, REEDM predictions of HCl concentrations that exceed the exposure criteria recommended by the HQ AFSPC/SG may or may not cause a launch

to be delayed (see Section 3.7 for detailed discussion of launch commit criteria). REEDM-predicted toxic air concentrations for combined nominal launches and launch failures would be the same as for the Atlas V and Delta IV systems evaluated individually because launches for the two systems would occur at separate times. Using procedures established for existing launch systems, risks to installation personnel and the general public have been minimized to acceptable levels during nominal launches and launch failures, in accordance with Eastern and Western Range (EWR) 127-1, as tailored.

TABLE 4.7-1
Comparison of Predicted Peak Ground-Level Concentrations to Exposure Criteria, Atlas V-551/552, CCAFS

		Nominal Launch				Launch Failure				
Emittent	Units	CCAS1	CCAS2	CCAS3	CCAS4	CCAS1	CCAS2	CCAS3	CCAS4	Exposure Criteria
NO_2	(ppm)	0	0	0	0	0	0	0	0	2[a]
HCl	(ppm)	0.244	0.161	0.466	0	0.540	9.905	0.435	13.776	10[b]
Al_2O_3	(mg/m^3)	0.005	0.002	0.006	0.001	0.015	0.153	0.012	0.157	5[c]
CO	(ppm)	0.003	0.003	0.003	0	0.025	0.018	0.020	0.015	35[d]
NH_3	(ppm)	0	0	0	0	0.001	0.001	0.001	0	35[e]

[a]Tier 1 criteria from HQ AFSPC/SG.
[b]Tier 2 criteria from HQ AFSPC/SG.
[c]Federal OSHA 8-hour TLV (Threshold Limit Value) for aluminum metal and aluminum oxide.
[d]NIOSH 8-hour TWA (Time-Weighted Average).
[e]NIOSH Short-Term (15 minutes) Exposure Limit (STEL).
Al_2O_3 = aluminum oxide.
O = carbon monoxide.
HCl = hydrogen chloride.
mg/m^3 = milligrams per cubic meter.
NH_3 = ammonia.
NO_2 = nitrogen dioxide.
ppm = parts per million.
REEDM = Rocket Exhaust Effluent Diffusion Model.

As stated in Section 3.7.2.2 of the 1998 FEIS, the facilities associated with the proposed Atlas V system with SRMs launches would be sited to meet Explosive Safety Quantity-Distance (ESQD) criteria.

4.7.1.1.2 Delta IV System

This section discusses impacts on Health and Safety at CCAFS from the addition of larger SRMs to Delta IV systems.

Regional Safety. CCAFS regional safety programs for launch operations involving the proposed Delta IV system with larger SRMs would be the same as regional safety programs for the current launch operations as described in Sections 3.7.2.1 of the 1998 FEIS and Section 4.7.1.1.1. Transportation of hazardous materials, including solid propellant, would occur as described in Section 4.7.1.1.1 for CCAFS.

Impact Debris Corridors. Boeing provided representative launch trajectories for launches of Delta IV vehicles with larger SRMs at CCAFS. These trajectories are included in Appendix Q. The trajectories shown in the appendix are not binding cases. Several figures

show where jettisoned spent SRMs are predicted to impact the Atlantic Ocean after launches of Delta IV vehicles.

Safety for Airmen, Mariners, and the public is ensured as described in Section 4.7.1.1.1. These scenarios represent no change from the No-Action Alternative, except for the SRM drop zones, which would be extended as a result of the longer burning times of the larger SRMs. It should be noted that the SW Safety Offices for Eastern Range adhere to an approval process for each lift vehicle and mission to ensure that the risks associated with lift vehicle operations do not exceed acceptable limits.

On-Station Safety. On-station safety programs for the proposed launch operations of the Delta IV system with larger SRMs would be the same as on-station safety programs for the current launch operations described in Sections 3.7.2.2 of the 1998 FEIS and Section 4.7.1.1.1, unless otherwise noted herein.

Normal launches of SRM-augmented Delta IV vehicles would generate NO_x, HCl, and Al_2O_3. During a launch mishap, ammonia (NH_3) would be generated from the RCS of the upper stage. Dispersion of launch emissions would be predicted using REEDM prior to a launch to determine a THC. The THC exposure concentrations for air contaminants would be compared to local risk management models and launch commit decision criteria. As a result of this comparison and risk estimation, emergency response preparations would be provided as described in Section 3.7.2.2 of the 1998 FEIS. No launch would occur if undue hazard existed for persons and property.

A summary of predicted ambient air concentrations for the above compounds is presented in Section 4.10.1.1.2. To assess air quality impacts during nominal launches and launch failures, the analysis considered a Delta IV MLV with four strap-on SRMs. The analysis also considered four meteorological cases (CCAFS1, CCAFS2, CCAFS3, and CCAFS4) at CCAFS. The REEDM-predicted concentrations used in this SEIS are screening concentrations only. Other conditions, such as weather assessed prior to actual launches, would result in predicted concentrations somewhat different from these values. For this analysis, it is conservatively assumed that all NO would be converted to NO_2. Table 4.7-2 summarizes a comparison of predicted peak ground-level concentrations from a normal launch and launch failure to AFSPC/SG-endorsed exposure criteria, OSHA standards, or NIOSH standards. No predicted concentrations for the meteorological cases from normal launches evaluated exceed the respective exposure criteria; therefore, no health or safety impacts would be expected as a result of airborne chemicals emitted from the use of larger SRMs.

As shown in Table 4.7-2, the predicted HCl concentration for meteorological cases CCAFS2 and CCAFS4 would exceed the exposure criteria for some launch failure scenarios (see Appendix T for details). Launch decisions, however, are not based directly on REEDM prediction; rather such decisions are based on the results of the probabilistic risk prediction (see Section 3.7). Thus, depending on the details of a launch, REEDM predictions of HCl concentrations that exceed the exposure criteria recommended by the HQ AFSPC/SG may or may not cause a launch to be delayed (see Section 3.7 for detailed discussion of launch commit criteria). Using procedures established for existing launch systems, risks to installation personnel and the general public have been minimized to acceptable levels during normal launches and launch failures, in accordance with EWR127-1, as tailored.

TABLE 4.7-2
Comparison of Predicted Peak Ground-Level Concentrations to Exposure Criteria, Delta IV Medium-Lift Vehicle with Four Strap-on SRMs, CCAFS

Emittent	Units	Nominal Launch				Launch Failure				Exposure Criteria
		CCAS1	CCAS2	CCAS3	CCAS4	CCAS1	CCAS2	CCAS3	CCAS4	
NO_2	(ppm)	0	0	0	0	0	0	0	0	2[a]
HCl	(ppm)	0.156	0.113	0.634	0	0.413	14.591	0.453	20.124	10[b]
Al_2O_3	(mg/m^3)	0.003	0.002	0.005	0.001	0.009	0.203	0.010	0.201	5[c]
CO	(ppm)	0.002	0.002	0.002	0	0.013	0.130	0.008	0.198	35[d]
NH_3	(ppm)	0	0	0	0	0	0	0	0	35[e]

[a]Tier 1 criteria from HQ AFSPC/SG.
[b]Tier 2 criteria from HQ AFSPC/SG.
[c]Federal OSHA 8-hour TLV (Threshold Limit Value) for aluminum metal and aluminum oxide.
[d]NIOSH 8-hour TWA (Time-Weighted Average).
[e]NIOSH Short-Term (15 minutes) Exposure Limit (STEL).
Al_2O_3 = aluminum oxide. CO = carbon monoxide. HCl = hydrogen chloride.
mg/m^3 = milligrams per cubic meter.
NH_3 = ammonia.
NO_2 = nitrogen dioxide.
ppm = parts per million.
REEDM = Rocket Exhaust Effluent Diffusion Model.

As stated in Section 3.7.2.2 of the 1998 FEIS, the facilities associated with the proposed Delta IV system with larger SRMs would be sited to meet ESQD criteria. The RIS facility is sited for 724,150 pounds of Class 1.3 propellant and 9.46 pounds of Class 1.1 propellant. The SRS facility is sited for 394,380 pounds of Class 1.3 propellant and 5.16 pounds of Class 1.1 propellant. 4.7.1.2 Vandenberg AFB.

4.7.1.2.1 Atlas V System

Regional Safety. Vandenberg AFB regional safety programs for operations of the proposed Atlas V system with SRMs would be the same as regional safety programs for the current launch systems at CCAFS, as described in Section 3.7.3.1 of the 1998 FEIS and Section 4.7.1.1.1. Transportation of hazardous materials, including solid propellant, would occur as described in Section 4.7.1.1.1 for CCAFS.

Impact Debris Corridors. Representative launch trajectories were provided by LMC for launches of Atlas V vehicles with SRMs at Vandenberg AFB and are included in Appendix Q. The trajectories shown are not binding cases. Several figures show where jettisoned spent SRMs are predicted to impact the Pacific Ocean after launches of Atlas V vehicles.

Safety for Airmen, Mariners, and the public is ensured as described in Section 4.7.1.1.1. Precautions would be taken to ensure that jettisoned bodies would not fall on offshore oilrigs or any of the Channel Islands. These scenarios represent no change from the No-Action Alternative except for the addition of SRM drop zones. The SW Safety Offices for the Western Range adhere to an approval process for each lift vehicle and mission to ensure that the risks associated with lift vehicle operations do not exceed acceptable limits.

On-Base Safety. On-base safety programs for the launch operations of the proposed Atlas V system with SRMs would be the same as on-station safety programs for the launch operations

described in Section 3.7.3.2 of the 1998 FEIS and Section 4.7.1.1.1 of this SEIS, unless otherwise noted herein.

Table 4.7-3 compares predicted peak ground-level concentrations from a normal launch and launch failure to AFSPC/SG-endorsed exposure criteria, OSHA standards, and NIOSH standards. To assess air quality impacts during normal launches and launch failures, the analysis considered an Atlas V system with five strap-on SRMs. The analysis also considered three meteorological cases (VAFB1, VAFB2, and VAFB3) at Vandenberg AFB. Other conditions, such as weather prior to actual launches, would result in predicted concentrations somewhat different from these values. For this analysis, it is conservatively assumed that all NO would be converted to NO_2. No predicted concentrations for the meteorological cases associated with normal launches evaluated in this SEIS exceed the exposure criteria used in this analysis. No Health or Safety impacts would be expected as a result of airborne chemicals emitted from the SRMs. Using procedures established for existing launch systems, risks to installation personnel and the general public have been minimized to acceptable levels during normal launches and launch failures, in accordance with Eastern and Western Range (EWR 127-1), as tailored.

TABLE 4.7-3
Comparison of Predicted Peak Ground-Level Concentrations to Exposure Criteria, Atlas V System with Five Strap-on SRMs, Vandenberg AFB

		Nominal Launch			Launch Failure			
Emittent	Units	VAFB1	VAFB2	VAFB3	VAFB1	VAFB2	VAFB3	Exposure Criteria
NO_2	(ppm)	0	0	0	0	0	0	2[a]
HCl	(ppm)	1.896	0	0	2.053	1.312	4.017	10[b]
Al_2O_3	(mg/m^3)	0.007	0.020	0.031	0.029	0.087	0.202	5[c]
CO	(ppm)	0.003	0	0	0.026	0.005	0.006	35[d]
NH_3	(ppm)	0	0	0	0.001	0	0	35[e]

[a]Tier 1 criteria from HQ AFSPC/SG.
[b]Tier 2 criteria from HQ AFSPC/SG.
[c]Federal OSHA 8-hour TLV (Threshold Limit Value) for aluminum metal and aluminum oxide.
[d]NIOSH 8-hour TWA (Time-Weighted Average).
[e]NIOSH Short-Term (15 minutes) Exposure Limit (STEL).
Al_2O_3 = aluminum oxide.
CO = carbon monoxide.
HCl = hydrogen chloride.
mg/m^3 = milligrams per cubic meter.
NH_3 = ammonia.
NO_2 = nitrogen dioxide.
ppm = parts per million.
REEDM = Rocket Exhaust Effluent Diffusion Model.

As stated in Section 3.7.3.2 of the 1998 FEIS, the facilities associated with the proposed Atlas V system with SRMs would be sited to meet ESQD criteria. SLC-3W is sited for 450,000 pounds of Class 1.1 explosives, while Building 960 is sited for 20,000 pounds of Class 1.1 explosives. Lightning mitigation measures would be required at SLC-3W, but not at Building 960.

4.7.1.2.2 Delta IV System

Regional Safety. Vandenberg AFB regional safety programs for the proposed Delta IV system with larger SRMs launch operations would be the same as regional safety programs for the

current launch operations, as described in Section 3.7.3.1 of the FEIS and Section 4.7.1.1.1. Transportation of hazardous materials, including solid propellant, would occur as described in Section 4.7.1.1.1 for CCAFS.

On-Base Safety. On-base safety programs for the operation of the proposed Delta IV system with larger SRMs would be the same as on-station safety programs for the launch operations described in Section 3.7.3.2 of the 1998 FEIS and Section 4.7.1.1.1, unless otherwise noted herein.

Table 4.7-4 compares predicted peak ground-level concentrations from a normal launch and launch failure to AFSPC/SG-endorsed exposure criteria, OSHA standards, and NIOSH standards. To assess air quality impacts during normal launches and launch failures, the analysis considered a Delta IV MLV with four strap-on SRMs. The analysis also considered three meteorological cases (VAFB1, VAFB2, and VAFB3) at Vandenberg AFB. Other conditions, such as weather prior to actual launches, would result in predicted concentrations that are somewhat different from these values. For this analysis, it is conservatively assumed that all NO would be converted to NO_2. No predicted concentrations for the nominal meteorological cases evaluated exceed the exposure criteria used in this analysis. No health or safety impacts would be expected as a result of airborne chemicals emitted from the larger SRMs. Using procedures established for existing launch systems, risks to installation personnel and the general public have been minimized to acceptable levels during nominal launches and launch failures, in accordance with Eastern and Western Range (EWR 127-1), as tailored.

TABLE 4.7-4
Comparison of Predicted Peak Ground-Level Concentrations to Exposure Criteria, Delta IV Medium-Lift Vehicle with Four Strap-on SRMs, Vandenberg AFB

		Nominal Launch			Launch Failure			
Emittent	Units	VAFB1	VAFB2	VAFB3	VAFB1	VAFB2	VAFB3	Exposure Criteria
NO_2	(ppm)	0	0	0	0	0	0	2[a]
HCl	(ppm)	1.270	0	0	1.378	3.399	4.777	10[b]
Al_2O_3	(mg/m^3)	0.005	0.020	0.045	0.018	0.130	0.208	5[c]
CO	(ppm)	0.002	0	0	0.014	0.100	0.057	35[d]
NH_3	(ppm)	0	0	0	0.001	0	0	35[e]

[a]Tier 1 criteria from HQ AFSPC/SG.
[b]Tier 2 criteria from HQ AFSPC/SG.
[c]Federal OSHA 8-hour TLV (Threshold Limit Value) for aluminum metal and aluminum oxide.
[d]NIOSH 8-hour TWA (Time-Weighted Average).
[e]NIOSH Short-Term (15 minutes) Exposure Limit (STEL).
Al_2O_3 = aluminum oxide.
CO = carbon monoxide.
HCl = hydrogen chloride.
mg/m^3 = milligrams per cubic meter.
NH_3 = ammonia.
NO_2 = nitrogen dioxide.
ppm = parts per million.
REEDM = Rocket Exhaust Effluent Diffusion Model.

As stated in Section 3.7.3.2 of the 1998 FEIS, the facilities associated with the proposed Delta IV system with larger SRMs would be sited to meet ESQD criteria.

4.7.1.3 Cumulative Impacts

This section discusses impacts from other programs within the project vicinity that, when considered with impacts from the Proposed Action, would result in cumulative impacts to health and safety.

4.7.1.3.1 Cape Canaveral Air Force Station

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. Therefore, there would be no cumulative impacts to the health and safety programs as a result of implementing the Proposed Action.

4.7.1.3.2 Vandenberg AFB

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. Therefore, there would be no cumulative impacts to the health and safety programs as a result of implementing the Proposed Action.

4.7.2 No-Action Alternative

This section summarizes the impacts of the No-Action Alternative on health and safety programs at CCAFS and Vandenberg AFB using information described in the 1998 FEIS. The No-Action Alternative will occur whether or not the Proposed Action is implemented.

4.7.2.1 Cape Canaveral Air Force Station

The existing regional and on-station safety programs described in the 1998 FEIS will remain in effect. Some of the Delta IV system vehicles will use the smaller SRMs discussed in the 1998 FEIS and will, therefore, produce an HCl toxic plume. Expected health and safety impacts resulting from the No-Action Alternative are discussed in Sections 4.7.1.1.1 and 4.7.1.2.1 in the 1998 FEIS. Although discussed in the 1998 FEIS, the SUS containing MMH and N_2O_4 is not part of the current Atlas V launch vehicle baseline for the No-Action Alternative. Similarly, the HUS containing A-50 and N_2O_4 (discussed in the 1998 FEIS) is not part of the current Delta IV lift vehicle baseline for the No-Action Alternative. Under the current baseline, no MMH, A-50, or NO_2 will be emitted from the upper stages, contrary to discussion in the 1998 FEIS.

Concentrations of HCl are predicted using REEDM prior to a launch to determine a THC for Delta IV MLV launches using the smaller GEM-46 SRMs. THC exposure concentrations are compared to local risk management models and launch-commit decision criteria. As a result of this comparison and risk estimation, emergency response procedures are implemented as described above. No launch will occur if undue hazard exists for persons and property.

Table 4.7-5 summarizes a comparison of REEDM-predicted HCl concentrations to AFSPC/SG-endorsed exposure criteria. These data were presented in the 1998 FEIS, Table 4.7-4. Estimated HCl exposure peak concentrations do not exceed the Tier 1 ceiling limit, which is the most protective for exposure criteria. Tier 1 values have not been recommended for hydrazine. Risks to installation personnel and the general public will be minimized to acceptable levels during nominal and failed launches, in accordance with EWR 127-1, as tailored. As described above, the REEDM-predicted concentrations used in this report are screening concentrations only; a systematic search for worst-case

meteorology was not conducted. Other conditions during actual launches will result in predicted concentrations somewhat different from these values. No concentrations are expected to exceed the respective exposure criteria; therefore, no health or safety impacts are expected as a result of airborne chemicals emitted from the smaller Delta IV SRMs.

TABLE 4.7-5
Comparison of REEDM-Predicted HCl Concentrations to Recommended Exposure Criteria, No-Action Alternative, Delta IV Medium-Lift Vehicle

	HCl Peak Concentration (ppm)		Tier 1 Exposure Criteria Ceiling Limit (ppm)
Vehicle	Nominal Launch	Failed	Ceiling Limit
DIV-M+	0.293	0.023	10

DIV M+ = Delta IV medium-lift vehicle with SRMs.
HCl = hydrogen chloride.
Ppm = parts per million.
REEDM = Rocket Exhaust Effluent Diffusion Model.
SRMs = Solid rocket motors.

A description of fire protection, alarm, and fire suppression systems is provided in Sections 2.1.1.4 and 2.1.2.4 of the 1998 FEIS. As stated in these sections, the facilities associated with No-Action Alternative Atlas V and Delta IV systems are sited to meet ESQD criteria. The flight termination systems (FTS) for Atlas V and Delta IV vehicles are described in Sections 2.1.1.1 and 2.1.2.1 of the 1998 FEIS.

4.7.2.2 Vandenberg AFB

The current regional and on-station safety programs described in Section 3.7.3 of the 1998 FEIS will remain in effect. Some of the Delta IV system vehicles will use the smaller SRMs, as discussed in the 1998 FEIS and will, therefore, produce an HCl toxic plume. Expected Health and Safety impacts resulting from the No-Action Alternative are discussed in Sections 4.7.1.1.2 and 4.7.1.2.2 in the 1998 FEIS. Although discussed in the 1998 FEIS, the SUS containing MMH and N_2O_4 is not part of the current Atlas V lift vehicle baseline for the No-Action Alternative. Similarly, the HUS containing A-50 and N_2O_4 discussed in the 1998 FEIS is not part of the current Delta IV lift vehicle baseline for the No-Action Alternative. Under the current baseline, no MMH, A-50, or NO_2 will be emitted from the upper stages, contrary to discussion in the 1998 FEIS.

Impacts from emissions of HCl from the smaller Delta IV SRMs are discussed in Section 4.7.2.1, at CCAFS. The REEDM-predicted HCl air concentrations to assess air quality impacts for nominal and failed Delta IV system launches are similar for Vandenberg AFB (i.e., less than 5 percent difference). No concentrations are predicted to exceed the respective exposure criteria; therefore, no health or safety impacts will be expected as a result of airborne chemicals emitted from the Delta IV SRMs.

A description of fire protection, alarm, and fire suppression systems is provided in Sections 2.1.1.4 and 2.1.2.4 of the 1998 FEIS. As stated in these sections, the facilities associated with Atlas V and Delta IV system launches are sited to meet ESQD criteria. The FTS for Atlas V and Delta IV system vehicles are described in Sections 2.1.1.1 and 2.1.2.1 of the 1998 FEIS.

4.8 Geology and Soils

This section describes the geology and soils impacts that would result from the Proposed Action (Section 4.8.1) and the No-Action Alternative (Section 4.8.2) at CCAFS and Vandenberg AFB.

4.8.1 Proposed Action

This section describes the impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems. The Proposed Action components (Atlas V and Delta IV systems) are not anticipated to result in impacts to geology and soils, either separately or in combination.

4.8.1.1 Cape Canaveral Air Force Station

4.8.1.1.1 Atlas V System

Geologic Setting. Construction and modification of existing facilities at SLC-41, is currently occurring as a result of activities analyzed in the 1998 FEIS. No new ground-disturbing construction would be required for the addition of SRMs on Atlas V vehicles. SLC-11, a facility not addressed in the 1998 FEIS, is proposed as a short-term contingency storage area for SRMs. This facility is an open pad that is already sufficient for the purpose and would not require modification. Under the Atlas V portion of the Proposed Action, there would be no change to the physiography of the region, nor would there be any impacts to any unique geologic features or geologic features of unusual scientific value.

Soils. As described above, no ground-disturbing construction would be required for the addition of SRMs to Atlas V vehicles at CCAFS, so no soils would be physically disturbed. However, use of SLC-41 for the Proposed Action would have a less than minimal adverse impact on soils as compared to the actions proposed in the 1998 FEIS. The ground cloud created by the SRMs causes deposition of HCl and aluminum oxide on the soil adjacent to the launch site, resulting in temporary acidification and an increase of aluminum in soils. As shown in Tables 2.1-1 and 2.1-2, the Proposed Action includes an increase in the number of launches of the Atlas V system. An increase in HCl and Al_2O_3 would be observed solely as a result of the number of SRM-augmented launches. It should be noted that SLC-41 was the site of Titan IV launches that used more than twice as much solid propellant per launch, so the deposition of solids-related material would be considerably less for the Proposed Action.

There would be no change in risk of soil contamination as the result of a launch anomaly. The unburned solid propellant could easily be collected because of its eraser-like consistency. In the unlikely event of a launch anomaly, any propellant would be collected and disposed of by a certified disposal subcontractor in accordance with the approved Spill Prevention Control and Contingency (SPCC) Plan. Contaminated soils would be removed and treated as hazardous waste in accordance with all federal, state, and local regulations. Short-term impacts to soils could result, but long-term impacts would not be significant.

Adherence to permit requirements would minimize and mitigate any adverse impacts to geology and soils; therefore, no additional mitigation measures would be required.

4.8.1.1.2 Delta IV System

Geologic Setting. The only ground-disturbing EELV program facility construction for the Delta IV system at CCAFS would occur at the RIS facility. The Proposed Action would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value. Exterior paving would affect areas already disturbed in the past. Therefore, no significant effects would occur.

Soils. Construction adjacent to the RIS facility would occur in an area that has previously been disturbed, and would not affect sloping land or unusual soil conditions. Adherence to permit requirements would minimize or mitigate any adverse impacts to geology and soils; therefore, no additional mitigation measures would be required.

Impacts from the use of SRMs would result in the deposition of HCl and aluminum oxide particulates on soils near the launch pad. As shown in Tables 2.1-1 and 2.1-2, the Proposed Action includes an increase in the number of launches of the Delta IV system. An increase in HCl and Al_2O_3 would be observed solely as a result of the number of SRM-augmented launches.

Acid deposition is discussed in detail in Section 4.8.1.1.1. No long-term effects from acid deposition are expected from proposed Delta IV launches at CCAFS. Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

4.8.1.2 Vandenberg AFB

4.8.1.2.1 Atlas V System

Geologic Setting. Construction and modification of existing facilities at SLC-3W is currently occurring as a result of the activities analyzed in the 1998 FEIS. No new ground-disturbing activities would occur from the proposed use of SRMs on Atlas V vehicles. Building 960, a facility not addressed in the 1998 FEIS, is proposed as a short-term contingency storage area for SRMs. This facility is not anticipated to be modified. As a result of the Proposed Action, there would be no change to the physiography of the region, nor would there be any impacts to any unique geologic features or geologic features of unusual scientific value.

Of geologic concern in the Vandenberg AFB region is the potential effect of earthquakes that could occur during launch program operations. The SLC-3W site is not in a potential landslide area nor is it near any sand dunes (U.S. Air Force, 1989a). The nearest active fault, the Hosgri Fault, lies 2.5 miles northwest of the site, and is capable of causing sustained ground shaking and/or surface rupture. Any modification of existing facilities would incorporate earthquake-resistant design, as required by California building codes, to reduce the potential for impacts from a seismic event, including surface rupture.

Soils. As described in Section 4.8.1.1.1, no ground disturbance would be required for the use of SRMs on Atlas V vehicles at Vandenberg AFB. Therefore, no soils would be physically disturbed. Adherence to permit requirements would minimize or mitigate adverse impacts to geology and soils; therefore, no additional mitigation measures would be required.

Impacts from the use of SRMs would result in the deposition of HCl and aluminum oxide particulates on soils near the launch pad. As shown in Tables 2.1-1 and 2.1-2, the Proposed Action includes an increase in the number of launches of the Atlas V system. An increase in HCl and Al_2O_3 would be observed solely as a result of the number of SRM-augmented

launches. Acid deposition is discussed in detail in Section 4.8.1.1.1, Atlas V System with SRMs, and Section 4.9.1.2.1, Atlas V System with SRMs. No long-term effects from acid deposition are expected from Atlas V launches at Vandenberg AFB.

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

4.8.1.2.2 Delta IV System

Geologic Setting. The only change that would be required for facilities to accommodate the use of larger SRMs for the Delta IV system at Vandenberg AFB is the interior modification of Building 945. No ground-disturbing construction would occur. The Proposed Action would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Of geologic concern in the Vandenberg AFB region is the potential effect of earthquakes that could occur during launch program operations. The nearest active fault, the Hosgri Fault, lies 7.5 miles northwest of the site, and is capable of causing sustained ground shaking and/or surface rupture. Modification of existing facilities would incorporate earthquake-resistant design, as required by California building codes, to reduce the potential for impacts from a seismic event, including surface rupture.

Soils. No new ground-disturbing construction activities would be required to accommodate the larger SRMs on Delta IV vehicles at Vandenberg AFB. Therefore, no soils would be physically disturbed.

Impacts from the use of SRMs would result in the deposition of HCl and aluminum oxide particulates on soils near the launch pad. As shown in Tables 2.1-1 and 2.1-2, the Proposed Action includes an increase in the number of launches of the Delta IV system. An increase in HCl and Al_2O_3 would be observed solely as the result of the number of SRM-augmented launches. Acid deposition is discussed in detail in Sections 4.8.1.1.1 and 4.9.1.2.2. No long-term effects from acid deposition are expected from Delta IV launches at Vandenberg AFB.

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under "Soils."

Adherence to permit requirements would minimize or mitigate adverse impacts to geology and soils; therefore, no additional mitigation measures would be required.

4.8.1.3 Cumulative Impacts

4.8.1.3.1 Cape Canaveral Air Force Station

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. Therefore, there would be no cumulative impacts to the geology and soils as a result of the cumulative effect of other programs and the Proposed Action at CCAFS.

4.8.1.3.2 Vandenberg AFB

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. Therefore, there would be no cumulative impacts to the geology and soils as the result of the Proposed Action at Vandenberg AFB.

4.8.2 No-Action Alternative

This section summarizes the impacts of the No-Action Alternative on geology and soils at CCAFS and Vandenberg AFB. The No-Action Alternative will occur whether or not the Proposed Action is implemented.

4.8.2.1 Cape Canaveral Air Force Station

Under the No-Action Alternative, no significant geology or soils impacts will occur, as described in Sections 4.8.1.1.1 and 4.8.1.2.1 in the 1998 FEIS.

4.8.2.2 Vandenberg AFB

Under the No-Action Alternative, no significant geology or soils impacts will occur, as described in Sections 4.8.1.1.2 and 4.8.1.2.2 in the 1998 FEIS.

4.9 Water Resources

4.9.1 Proposed Action

This section describes impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems. The Proposed Action components (Atlas V and Delta IV systems) are not anticipated to result in impacts to the supply or quality of groundwater or surface water, either separately or in combination. Water requirements for the Proposed Action are provided in Table 4.9-1, and total water usage by year is included in Table 4.9-2.

TABLE 4.9-1
Total Water Usage Per Launch and During Peak Year, Proposed Action

Lift Vehicle System	Maximum Water Usage Per Launch (gallons)	Estimated Number of Launches (peak year)	Total Maximum Water Usage in Gallons
CCAFS			
Atlas V			
300/400	600,000	1	
500 Series	600,000	10	
Heavy	600,000	1	
		(2008)	7,200,000
Delta IV[1]			
DIV M	185,000	4	
DIV M+	185,000	10	
		(2006)	2,590,000
Vandenberg AFB			
Atlas V			
300/400	600,000	1	
500 Series	600,000	3	
Heavy	600,000	1	
		(2008)	3,000,000
Delta IV[1]			
DIV M	185,000	1	
DIV M+	185,000	3	
DIV H	185,000	1	
		(2007)	925,000

Refer to Section 2 for vehicle definitions (2.1.3).
DIV M = Delta IV medium-lift vehicle (MLV).
DIV M+ = Delta IV MLV with SRMs.
DIV H = Delta IV heavy-lift vehicle.
[1]Approximately 70-80% of total water used for each launch will be water recycled from previous launch. Values represent total usage, including recycled portion.

TABLE 4.9-2
Total Water Usage by Year for Total Launches under the Proposed Action

	Total Launches		Total Water Usage (gal.)	
Launch Year	Atlas V	Delta IV	Atlas V	Delta IV
2001	0	1	0	185,000
2002	5	6	3,000,000	1,110,000
2003	10	13	6,000,000	2,405,000
2004	15	17	9,000,000	3,145,000
2005	15	14	9,000,000	2,590,000
2006	14	17	8,400,000	3,145,000
2007	15	17	9,000,000	3,145,000
2008	17	15	10,200,000	2,775,000
2009	15	15	9,000,000	2,775,000
2010	16	16	9,600,000	2,960,000
2011	15	16	9,000,000	2,960,000
2012	16	15	9,600,000	2,775,000
2013	15	18	9,000,000	3,330,000
2014	16	14	9,600,000	2,590,000
2015	16	16	9,600,000	2,960,000
2016	15	16	9,000,000	2,960,000
2017	15	15	9,000,000	2,775,000
2018	17	15	10,200,000	2,775,000
2019	14	17	8,400,000	3,145,000
2020	17	15	10,200,000	2,775,000

4.9.1.1 Cape Canaveral Air Force Station

4.9.1.1.1 Atlas V System

Water Supply. For the Atlas V system, the addition of SRMs would not require any additional water for cooling or acoustic damping than as required for the No-Action Alternative. The maximum amount of water needed per launch would be 600,000 gallons of which approximately 300,000 gallons would be recovered. This usage would be the same as for the No-Action Alternative. During the expected peak launch year (2008), Atlas V launch activities at CCAFS (12 launches) would require approximately 7.2 million gallons of water.

CCAFS receives its potable water from the City of Cocoa. The quantity of water available to CCAFS and the surrounding area (the amount of water withdrawn from the Floridan aquifer on a daily basis) is not anticipated to change from that forecast for the No-Action Alternative, so no impact to groundwater resources is expected, and no mitigation measures would be required.

Surface Water. The Atlas V portion of the Proposed Action at CCAFS would not necessitate any ground-disturbing construction. As a result, there would be no change to surface drainage patterns from the forecast for the No-Action Alternative. The Proposed Action

would not alter the existing drainage course, so adverse impacts to natural drainage would not be anticipated.

For the Proposed Action, there would be no changes in NPDES permit requirements for stormwater discharge.

Water Quality. SRMs produce HCl in the exhaust plume. Water used for sound suppression, cooling, and washdown would contain some HCl that would be collected and treated as industrial wastewater before being discharged. Discharged wastewater would meet permit conditions and would be released to permitted percolation areas. Wastewater discharges would not adversely affect surface water quality. Hydrochloric gas in the exhaust plume would be carried away from the launch site. Past monitoring and deposition modeling has shown that launches of large SRMs during light rainfall and slow wind conditions could cause deposition of variable concentrations of acid, which could also cause adverse effects to surface water and biota. Launches during some weather conditions could cause deposition of HCl. Deposition near the launch pad is not modeled by the REEDM, but has been monitored at CCAFS where it was determined that most acid deposition occurred within a few hundred meters of the launch pad. Deposition at distances starting at about 1,000 meters or more from the launch site can be predicted by REEDM (Appendix R) which indicates a maximum of 13,080 milligrams per square meter of hydrochloric acid could be deposited. The amounts of HCl deposited could cause temporary reductions in pH in small isolated pools, but would be quickly neutralized by the carbonate minerals present in soil, bedrock, and surface water at CCAFS.

In the event of an anomaly on the launch pad, any unburned solid-propellant dispersed by the explosion would not likely reach surface waters. In the event of an anomaly after launch, but still near the ground, unburned solid-propellant (Table 2.1-4) could fall on surface waters. Ammonium perchlorate in the propellant is soluble in water, but dissolves slowly. Trace amounts could disassociate into ammonium ion and perchlorate ion. At low to moderate concentrations, ammonium ion is a plant nutrient and could stimulate plant growth for short periods of time. At higher concentrations, the ammonium ion is toxic to aquatic life and could cause short-term mortalities of aquatic animals. The perchlorate ion is somewhat toxic because it reacts with (oxidizes) organic matter with which it comes into direct contact. HTPB could be biologically degraded over time. Powdered aluminum would rapidly oxidize to aluminum oxide, which is non-toxic at the pH that prevails in surface waters surrounding CCAFS.

4.9.1.1.2 Delta IV System

Water Supply. For the Delta IV system, the use of larger SRMs would not affect the quantity of water needed for launch activities. Delta IV launches would not require the use of deluge water. The maximum amount of water needed for a launch would be 185,000 gallons per launch. This use would be the same as for the No-Action Alternative. During the expected peak launch year (2006), Delta IV launch activities at CCAFS (14 launches) would require approximately 2,590,000 gallons of water.

The quantity of water available to CCAFS and the surrounding area (the amount of water withdrawn from the Floridan aquifer on a daily basis) is not anticipated to change from that forecasted for the No-Action Alternative, so adverse impacts to groundwater resources would not be expected, and no mitigation measures would be required.

Surface Water. The Delta IV portion of the Proposed Action would necessitate minor paving activity. However, there would be no change to surface drainage patterns at the site through excavation, grading, or the creation of impervious surfaces from the forecast for the No-Action Alternative, so adverse impacts to natural drainage would not be anticipated.

For the Proposed Action, there would be no changes in NPDES permit requirements for stormwater discharge associated with construction activity. Compliance with Section 404 of the Clean Water Act (CWA) would not change from the No-Action Alternative. No adverse impacts to surface water would be expected.

Water Quality. SRMs produce HCl in the exhaust plume. Water used for washdown and IPS would contain some HCl that would be collected and treated as industrial wastewater before being discharged. Discharged wastewater would meet permit conditions and would be released into permitted percolation areas. Discharged wastewater would not adversely affect surface water quality. Hydrochloric gas in the exhaust plume would be carried away from the launch site. Past monitoring and deposition modeling have shown that launches of large SRMs during light rainfall and slow wind conditions could cause deposition of various concentrations of acid, which could also cause adverse effects to surface water and biota. Deposition near the launch pad cannot be predicted by REEDM (Appendix R), but has been monitored at CCAFS, where most deposition occurred within a few hundred meters. REEDM predicts deposition at distances of about 1,000 meters or more from the launch site as a consequence of rain scrubbing acid from the exhaust cloud. Deposition modeling (Appendix R) indicates that a maximum of 14,094 milligrams per square meter of hydrochloric acid would be deposited approximately 1,000 meters from the launch. The amounts of HCl deposited could cause temporary reductions in pH in small isolated pools, but would be quickly neutralized by the carbonate minerals present in soil, bedrock, and surface water at CCAFS.

In the event of an anomaly on the launch pad, any unburned solid-propellant dispersed by the explosion would not be likely to reach surface waters. In the event of an anomaly after launch but still near the ground, unburned propellant (Table 2.1-4) could fall on surface waters. Ammonium perchlorate in the propellant is soluble in water, but dissolves slowly. Trace amounts could disassociate into ammonium ion and perchlorate ion. At low to moderate concentrations, the ammonium ion is a plant nutrient and could stimulate plant growth for short periods of time. At higher concentrations, the ammonium ion is toxic to aquatic life and could cause short-term mortalities of aquatic animals. The perchlorate ion is moderately toxic, because it reacts with (oxidizes) organic matter with which it comes into direct contact. HTPB could be biologically degraded over time. Powdered aluminum would rapidly oxidize to aluminum oxide, which is non-toxic at the pH that prevails in surface waters surrounding CCAFS.

4.9.1.2 Vandenberg AFB

4.9.1.2.1 Atlas V System

Water Supply. For the Atlas V system, the addition of SRMs would require no more additional water for cooling or acoustic damping than for the No-Action Alternative. The maximum amount of water needed per launch would be 600,000 gallons of which 300,000 gallons would be recovered. This usage would be the same as for the No-Action

Alternative. During the expected peak launch year (2008), Atlas V launch activities at Vandenberg AFB (5 launches) would require approximately 3 million gallons of water.

Water would be piped to SLC-3W from the State Water Project. The base has a contract to receive nearly 5 million gallons of water per day from the state, which will easily accommodate the increased launch water usage. Vandenberg AFB is currently contracted to receive 5,500 acre-feet per year from the state (with a drought buffer concentrated volume of 6,000 acre-feet per year). The base currently uses 4,000 to 4,500 acre-feet per year. The supplier and the quantity of water available to Vandenberg AFB and the surrounding area is not anticipated to change from that forecasted for the No-Action Alternative. The Proposed Action would not affect the quantity of water available to Vandenberg AFB and the surrounding area. Therefore, adverse impacts to groundwater resources are not expected, and no mitigation measures would be required.

Surface Water. The Atlas V portion of the Proposed Action at Vandenberg AFB would not necessitate any ground-disturbing construction. As a result, there would be no change from the forecast in the No-Action Alternative to surface drainage patterns. Therefore, adverse impacts to natural drainage are not anticipated.

For the Proposed Action, there would be no changes in NPDES permit requirements for stormwater discharge. Compliance with Section 404 of the CWA would not change from the No-Action Alternative. No adverse impacts to surface water would be expected.

Water Quality. SRMs produce HCl in the exhaust plume. Water used for sound suppression, cooling, and washdown would contain some HCl that will be collected and trucked to an offsite facility to be disposed of in accordance with federal, state, and local requirements. No direct discharges of wastewater would occur at Vandenberg AFB; therefore, there should be no adverse affects to surface water quality. Hydrochloric gas in the exhaust plume would be carried away from the launch site. Past monitoring and deposition modeling has shown that launches of large SRMs during light rainfall and slow wind conditions can cause deposition of various concentrations of acid which could also cause adverse effects to surface water and biota. Launches during some weather conditions can cause deposition of HCl. Modeling has not been used to predict deposition close to the launch pad where most acid would be deposited, but monitoring at CCAFS has shown that deposition of acid is usually limited to a few hundred meters from the launch pad. Deposition can be predicted at distances of about 1,000 meters or more from the launch site as a consequence of rain falling through the exhaust cloud and scrubbing acid as it does so can be predicted by REEDM (Appendix R). Launches during rainfall are relatively rare because of launch criteria developed to protect against lightning strikes. However, such launches do occasionally occur. As an example of potential effects , deposition modeling (Appendix R) indicates a maximum of 8,100 milligrams per square meter of hydrochloric acid would be deposited beginning at about 1,000 meters from the launch, with deposition then decreasing with distance from the launch site. The amounts of HCl deposited could cause temporary reductions in pH in small surface water bodies. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing minerals. However, the proximity to the ocean combined with the prevailing onshore winds cause the deposition of acid-neutralizing sea salt at Vandenberg AFB. The alkalinity derived from sea salt would neutralize acid falling on soil and prevent the production of acid runoff. Monitoring data provided by the Air

Force indicate that Bear Creek, the stream closest to the Atlas V system launch site, has alkalinities upward of 250 mg/L as $CaCO_3$ and pH in excess of 7.1; both indications that any HCl deposited directly on the water would be quickly neutralized (see Appendix R). In theory, that amount of deposition would consume about half of the alkalinity available in the monitored water bodies, assuming a depth of 10 centimeters. There should be no long-term effects of acid deposition on surface waters.

In the event of an anomaly on the launch pad, any unburned solid-propellant dispersed by the explosion would not be likely to reach surface waters. In the event of an anomaly after launch but still near the ground, unburned solid propellant (Table 2.1-4) could fall on surface waters. Ammonium perchlorate in the propellant is soluble in water, but dissolves slowly. Trace amounts could disassociate into ammonium ion and perchlorate ion in water. At low to moderate concentrations, the ammonium ion is a plant nutrient and could stimulate plant growth for short periods of time. The perchlorate ion is moderately toxic, because it reacts with (oxidizes) organic matter with which it comes into direct contact. HTPB could be biologically degraded over time. Powdered aluminum would rapidly oxidize to aluminum oxide, which is non-toxic at the pH that prevails in surface waters surrounding Vandenberg AFB.

4.9.1.2.2 Delta IV System

Water Supply. For the Delta IV system, the use of larger SRMs would not affect the quantity of water needed for launch activities. Delta IV launches would not require the use of deluge water. The maximum amount of washdown and IPS water needed would be 185,000 gallons per launch; the same is needed for the No-Action alternative. During the expected peak launch year (2007), Delta IV system launch activities at Vandenberg AFB (5 launches) would require approximately 925,000 gallons of water.

Water would be piped to SLC-6 from the State Water Project. The supplier and the quantity of water available to Vandenberg AFB and the surrounding area is not anticipated to change from that forecast for the No-Action Alternative. The Proposed Action would not affect the quantity of water available to Vandenberg AFB and the surrounding area, so adverse impacts to groundwater resources are not expected, and no mitigation measures would be required.

Surface Water. The Delta IV portion of the Proposed Action at Vandenberg AFB would not necessitate ground-disturbing construction, so there would be no change in the surface drainage patterns from the forecast for the No-Action Alternative. As a result, adverse impacts to natural drainages are not anticipated.

For the Proposed Action, there would be no changes in NPDES permit requirements for stormwater discharge associated with construction activity. Compliance with Section 404 of the CWA would not change from the No-Action Alternative. No adverse impacts to surface water would be expected.

Water Quality. SRMS produce HCl in the exhaust plume. Water used for washdown would contain some HCl that would be collected, treated, and recycled or disposed of in accordance with Federal, State, and local requirements. No direct discharges of wastewater are expected to occur at Vandenberg AFB, so there would be no adverse effects to surface water quality. Hydrochloric gas in the exhaust plume would be carried away from the

launch site. Past monitoring and deposition modeling have shown that launches of large SRMs during light rainfall and slow wind conditions could cause deposition of various concentrations of acid, which could also cause adverse effects to surface water and biota. Launches during some weather conditions could cause deposition of HCl. Based on monitoring of launches at CCAFS most acid deposition occurs within a few hundred meters of the launch pad. Deposition of acid at distances of about 1,000 meters or more from the launch site can be predicted by REEDM. For example, deposition modeling (Appendix R) indicates a maximum of 5,434 milligrams per square meter of hydrochloric acid would be deposited as dry particles at about 4,000 meters from the launch, with decreasing amounts at greater distance. In theory, that amount of deposition would consume about one-fourth of the alkalinity available in the monitored water bodies, assuming a depth of 10 centimeters, as shown in the example in Appendix R. The amounts of HCl deposited could cause temporary reductions in pH in small surface water bodies. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing chemicals, but the proximity to the ocean, combined with the prevailing onshore winds, cause the deposition of acid-neutralizing sea salt at Vandenberg AFB. The alkalinity derived from sea salt would neutralize acid falling on soil and prevent the production of acid runoff. Monitoring data provided by the Air Force indicate that Cañada Honda Creek, the stream closest to SLC-6, has alkalinities of 240 to 350 mg/L as $CaCO_3$ and pH in excess of 7.3; both approximations of alkalinity levels indicate that any HCl deposited directly on the water would be quickly neutralized (see Appendix R). No long-term effects of acid deposition on surface waters are anticipated to occur.

In the event of an anomaly on the launch pad, any unburned solid propellant dispersed by the explosion would not likely reach surface waters. In the event of an anomaly after launch, but still near the ground, unburned solid-propellant (Table 2.1-4) could fall on surface waters. Ammonium perchlorate in the propellant is soluble in water, but dissolves slowly. Trace amounts could disassociate into ammonium ion and perchlorate ion. At low to moderate concentrations, the ammonium ion is a plant nutrient and could stimulate plant growth for short periods of time. At higher concentrations, the ammonium ion is toxic to aquatic life and could cause short-term mortalities of aquatic animals. The perchlorate ion is moderately toxic, because it reacts with (oxidizes) organic matter that it comes into direct contact with. HTPB could be biologically degraded over time. Powdered aluminum would rapidly oxidize to aluminum oxide, which is non-toxic at the pH that prevails in surface waters surrounding Vandenberg AFB.

4.9.1.3 Cumulative Impacts

This section summarizes the cumulative impacts of other activities on water quality.

4.9.1.3.1 Cape Canaveral Air Force Station

The Proposed Action would replace government launches of Titan, Atlas, and Delta lift vehicles that currently occur at this location. No other projects in the area would be affected by activities at CCAFS. As a result, no additional cumulative impacts associated with the Proposed Action and other launch programs (such as the Space Shuttle) would occur to groundwater, surface water, or water quality.

4.9.1.3.2 Vandenberg AFB

The Proposed Action would replace government launches of existing Titan, Atlas, and Delta launch programs at Vandenberg AFB. In addition, there are no proposed developments in the vicinity of Vandenberg AFB or the launch trajectories. As a result, no additional cumulative impacts would occur to groundwater surface water, or water quality.

4.9.2 No-Action Alternative

This section summarizes the impact of the No-Action Alternative using information described in the 1998 FEIS, which includes implementation of the previously analyzed EELV program operations assessed in that document and allowed for implementation in the ROD for 1998 FEIS. The No-Action alternative will occur whether or not the Proposed Action is implemented. Water requirements for the No-Action Alternative are provided in Table 4.9-3. Total water usage by year for both CCAFS and Vandenberg AFB is included in Table 4.9-4.

TABLE 4.9-3
Total Water Usage Per Launch and During Peak Year, No-Action Alternative

Lift Vehicle System	Maximum Water Usage Per Launch (gallons)	Estimated Number of Launches (peak year)	Total Maximum Water Usage (gallons)
CCAFS			
Atlas V			
300/400	600,000	9	
Heavy	600,000	1	
		(2008)	6,000,000
Delta IV[1]			
DIV M	185,000	3	
DIV M+	185,000	6	
DIV H	185,000	2	
		(2013)	2,035,000
Vandenberg AFB			
Atlas V			
300/400	600,000	4	
Heavy	600,000	1	
		(2008)	3,000,000
Delta IV[1]			
DIV M	185,000	1	
DIV M+	185,000	3	
DIV H	185,000	1	
		(2007)	925,000

Refer to Section 2 for vehicle definitions (2.1.3).

DIV M = Delta IV medium-lift vehicle (MLV).

DIV M+ = Delta IV MLV with SRMs.

DIV H = Delta IV heavy-lift vehicle.

[1]Approximately 70-80% of total water used for each launch will be water recycled from previous launch. Values represent total usage, including recycled portion.

TABLE 4.9-4
Total Water Usage by Year for Total Launches under the No-Action Alternative

Launch Year	Total Launches		Total Water Usage (gal.)	
	Atlas V	Delta IV	Atlas V	Delta IV
2001	0	1	0	185,000
2002	3	4	1,800,000	1,480,000
2003	5	9	3,000,000	3,330,000
2004	11	12	6,600,000	4,440,000
2005	11	10	6,600,000	3,700,000
2006	13	13	7,800,000	4,810,000
2007	13	15	7,800,000	5,550,000
2008	15	13	8,400,000	4,810,000
2009	13	13	7,800,000	4,810,000
2010	14	14	8,400,000	5,180,000
2011	13	14	7,800,000	5,180,000
2012	14	13	8,400,000	4,810,000
2013	13	16	7,800,000	5,920,000
2014	14	12	8,400,000	4,440,000
2015	14	14	8,400,000	5,180,000
2016	12	14	7,200,000	5,180,000
2017	13	13	7,800,000	4,810,000
2018	14	13	8,400,000	4,810,000
2019	12	15	7,200,000	5,550,000
2020	14	13	8,400,000	4,810,000

4.9.2.1 Cape Canaveral Air Force Station

Water Supply. Water requirements for the No-Action Alternative are provided in Table 4.9-4. The total amount of water needed for the No-Action Alternative at CCAFS during the expected peak launch year (2015) will be 7.4 million gallons. During preparation of the 1998 FEIS, total water usage of up to 2.4 million gallons per year was reported based on the requirements of similar lift vehicles. More definitive design data now indicate a need for additional water usage. The additional water usage represents a reevaluation of the water needed for the No-Action Alternative. No adverse impacts on the regional water systems are anticipated for the No-Action Alternative as a result of the additional water usage.

Surface Water. Adverse impacts to natural drainage are not anticipated for the No-Action Alternative. Given compliance with NPDES and 404 permit regulations, no adverse impacts to water resources are expected. Standard construction practices and adherence to permit requirements and applicable regulations will minimize impacts to water resources; therefore, no mitigation measures are required.

Water Quality. Water quality in the area could be affected as a result of contamination of surface waters by the launch exhaust cloud. Some launches will require use of deluge, acoustic suppression, and washdown water. During the expected peak launch year, launch activities at CCAFS would require approximately 6 million gallons of water. The 1998 FEIS reported a total use of 2.4 million gallons based on the requirements of similar lift vehicles. More definitive design data indicate a need for additional water. The additional water use represents a reevaluation of the water needed. Residual deluge water generated during vehicle launches is a potential source of contamination to adjacent surface waters and groundwater. However, deluge water will be retained in the flame duct after launches; it will be tested for water quality characteristics and will be released to grade, in accordance with the FDEP Industrial Wastewater Discharge permit requirements. Deluge water will be released at a controlled rate to ensure that water percolates into the ground. If contaminant concentrations in the treated deluge water are too high and the water cannot be released to grade, it will be released to the wastewater treatment plant (WWTP). Wastewater will be disposed of in accordance with applicable federal, state, and local regulations.

Stormwater runoff prior to washdown will be contained to avoid the potential for impacts to surface water resources. Stormwater runoff will be tested and treated, if necessary, prior to release. Adverse impacts to surface water and groundwater quality resulting from deluge and stormwater runoff are not anticipated.

4.9.2.2 Vandenberg AFB

Water Supply. Water requirements for the No-Action Alternative are provided in Table 4.9-3. The total amount of water needed for the No-Action Alternative during the peak year (2008) will be 3.2 million gallons. The 1998 FEIS reported a total water use of 1.3 million gallons based on the requirements of similar lift vehicles. More definitive design data indicate a need for additional water. The additional water use represents a re-evaluation of the water needed. No adverse impacts on the regional water systems are anticipated for the No-Action Alternative.

Surface Water. Adverse impacts to natural drainage are not anticipated for the No-Action Alternative. Given compliance with NPDES and 404 permit regulations, no adverse impacts to water resources are expected. Standard construction practices and adherence to permit requirements and applicable regulations will minimize impacts to water resources, so no mitigation measures will be required.

Water Quality. Residual water is a potential source of contamination to adjacent surface waters and groundwater, but no direct discharge is expected to occur during launches at Vandenberg AFB. Deluge, acoustic suppression, washdown and IPS water will be collected, tested, and treated, if necessary, prior to recycling or disposal. If the water is classified as hazardous, it will be containerized and disposed of properly to avoid the potential for impacts to surface water resources. Adverse impacts to surface water or groundwater resulting from deluge, acoustic suppression or washdown water runoff are not anticipated. Potential releases of propellants during preparation for launches and during launches, including launch anomalies were found not to have adverse impacts in the 1998 FEIS.

4.10 Air Quality (Lower Atmosphere)

This section describes the air quality impacts to the lower atmosphere, from ground level to an altitude of 3,000 feet, that would result from the Proposed Action (Section 4.10.1) and the No-Action Alternative (Section 4.10.2). The Air Force Eastern and Western Range safety offices conducted REEDM runs for the air quality assessment in this section using the same soundings and launch scenarios (nominal and launch failure). Appendix T contains a discussion of the inputs to the REEDM (see Appendix T). For purposes of this Proposed Action, REEDM was used to produce a deterministic predicted toxic hazard corridor (THC) for both a credible failure mode, and for nominal emissions. Inputs to this model include real-time/forecasted meteorological conditions using rawinsonde balloons (a meteorological balloon used to provide various weather parameters required for use in range safety physics models); an accurate vehicle specific database; and probable failure modes. REEDM, Version 7.09, (Bjorklund, 1990) produces outputs in terms of peak concentration, time-average concentration of user-inputted time interval, and dosage estimates as required for exposure criteria for each chemical species being analyzed. The output is also used to estimate ambient air quality concentrations in the lower atmosphere for both nominal launch and launch failure scenarios.

In addition to using a deterministic model for deflagration/conflagration analyses (buoyant emissions involving combustion), the Eastern Range (CCAFS) uses the air dispersion model Ocean Breeze Dry Gulch (OB/DG), while moving towards a pollutant trajectory and concentration model known as the Hybrid Particle and Concentration Transport (HYPACT) model, to establish operation pre-clear distances for launch processing and to plot downwind concentrations in the event of an accidental release of toxic commodities without combustion. Both of these models, along with other range safety physics models, including REEDM and BLASTX, are part of the Eastern Range Dispersion Assessment System (ERDAS). The Western Range (VAFB) uses the AFTOX model to perform this same function and will be provided ERDAS capability/platforms under the Range Standardization and Automation (RSA) project. For purposes of comparison, the 1998 FEIS launch emissions for Atlas V 300/400 and heavy vehicles are also presented here (Brady, et al., 1997). New REEDM runs were conducted for Atlas V 550 and Delta IV M+ vehicles using site-specific meteorological data and more accurate vehicle-specific databases. In addition, the REEDM runs accounted for various launch failure modes, as well as for the nominal cases run for the DSEIS.

4.10.1 Proposed Action

This section describes the impacts that would result from the Proposed Action, which includes both the Atlas V and Delta IV systems.

4.10.1.1 Cape Canaveral Air Force Station

4.10.1.1.1 Atlas V System

The launch emissions associated with proposed Atlas V operations at CCAFS are described in the following paragraphs. Table 4.10-1 shows the Atlas V launch emissions released below 3,000 feet in altitude for Cape Canaveral, including emissions from the proposed MLVs with SRMs (551/552). For the purpose of this analysis, emissions were calculated using the geosynchronous transfer orbit (GTO) trajectory. For emissions into the lower atmosphere (0 to 3,000 feet) the differences between trajectories were not sufficient to warrant separate analyses.

TABLE 4.10-1
CCAFS Atlas V Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x [a]	CO	SO_2	PM_{10} [b]	HCl [c]
Atlas V 300/400	0	0.42	0	0	0	0
Atlas V 551/552[d]	0	1.1	0.01	0	15	7.8
Atlas V Heavy	0	1.2	0	0	0	0

[a]Mass assumes all nitrogen oxide oxidized to nitrogen dioxide.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.
[d]Proposed MLVs with SRMs.

For the Atlas V 300/400 and Atlas V Heavy vehicles, launch emissions estimates from the 1998 FEIS are presented for comparison purposes. These vehicles are unchanged from the 1998 FEIS; however, the launch vehicle categories shown here are grouped slightly differently from those presented in 1998 FEIS. The Atlas V 300/400 and Atlas V Heavy categories in this FSEIS represent the Atlas V MLV-A and Atlas V HLV-G categories described in the 1998 FEIS, respectively.

The emissions listed in Table 4.10-1 are for the Atlas V 550 series of vehicles. For the purposes of the atmospheric emissions analyses, the vehicle configuration with 5 SRMs was assumed to represent the upper bound. Computer model calculations were used to estimate the deposition rate of various chemical species in the wake of the launch vehicle. The emissions for the core vehicle and the SRMs were calculated separately. Representative trajectories were provided by LMC.

Four meteorological cases were investigated for the CCAFS launches: CCAFS1, CCAFS2, CCAFS3, and CCAFS4. The rawinsonde data files for these cases were chosen as representative of conditions at the launch site. For case CCAFS1, the rawinsonde data file is from an April 24, 1996, afternoon sounding taken in association with a Titan launch. A well-defined temperature inversion with a 6 degree Celsius gradient over 200 feet has a base at 3,450 feet above the ground. Winds from the ground to the inversion base are primarily from the north shifting to westerly winds above the inversion. The surface layer is moist and near neutral stability.

For case CCAFS2, the rawinsonde data file is from a January 22, 1996, nighttime sounding with a deep surface layer of moist air associated with a cold front over southern Florida. A mild surface-based inversion exists of approximately 1 degree Celsius differential, and a stronger elevated inversion exists at 6,000 feet above the ground. Winds in the surface layer are moderate speed from the northeast. Above the inversion, the airflow is drier and from the northwest.

For case CCAFS3, the rawinsonde data file is from a September 25, 1992, predawn sounding with a weak inversion based at 4,900 feet. Winds below the inversion are from the east to southeast. This surface layer is moist with near neutral stability. There is little shear across the inversion with air above the inversion being slightly stable. This meteorological case describes a high over the eastern United States, producing easterly winds with a potential for causing adverse inland toxic hazard corridors. This case features a vertically uniform wind direction

with light wind speeds at approximately 7 meters per second for most of the mixing layer. The light uniform winds make this scenario a case of interest for particulate deposition analyses.

For case CCAFS4, the rawinsonde data file is from a July 2, 1996, nighttime sounding taken in association with a Titan launch. The profile is characterized by a weak ground based stable layer above which is a deep layer of neutral stability air. The ground based stable layer is indicative of the formation of a nocturnal radiation inversion that forms as the ground cools during the night more quickly than the air. Two launch scenarios, a nominal launch and a launch failure, were investigated for each vehicle for each meteorological case. The effluents from a nominal launch are calculated by REEDM using the NASA Lewis Chemical Equilibrium (CET89) Program. The launch failure scenario was modeled by REEDM, which refers to the liquid propellant fireball as a "deflagration" event and refers to the burning solid propellant fragments as a "conflagration" event. The U. S. Air Force Eastern and Western Range Safety Offices ran the model and provided the results. Details of the inputs, assumptions, and model results are provided in Appendix T.

Tables 4.10-2 and 4.10-3 show the estimated downwind concentrations from the nominal launch and launch-failure scenarios at CCAFS, respectively. Table 4.10-4 shows the estimated maximum modeled concentrations of emissions by the Atlas MLVs with SRMs in comparison with the applicable standards. Multiplying the 1-hour Al_2O_3 concentration for nominal launches by 1,000 (to convert from milligrams to micrograms), and then dividing by 24 determined the 24-hour PM_{10} concentration. Also, dividing the 1-hour CO and 1-hour Al_2O_3 concentrations for launch failures by 8 determined the 8-hour CO and 8-hour Al_2O_3 concentrations. With the exception of HCl in some launch failure scenarios, all the predicted concentrations are less than the standards. For case CCAFS4, the HCl peak concentration exceeds the exposure criteria recommended by HQ AFSPC/SG. As discussed in Sections 3.7 and 4.7, launch decisions, however, are not based directly on REEDM predictions, but rather on the results of probabilistic risk predictions. Thus, depending on the details of a launch, REEDM predictions of HCI concentrations that exceed the exposure criteria recommended by the HQ AFSPC/SG may or may not cause a launch to be delayed (see Sections 3.7 and 4.7 for detailed discussion of launch commit criteria).

TABLE 4.10-2
Maximum Downwind Concentrations for Nominal Atlas V Launches at CCAFS

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS case	60-minute	0.013[c]	0	0	0
Atlas V Heavy	1998 FEIS case	60-minute	0.025[c]	0	0	0
Atlas V 551/552[d]	CCAFS1	Peak, Instantaneous	0	0.244	0.404	0.199
		30-minute	0	0.059	0.074	0.049
		60-minute	0	0.030	0.037	0.025
	CCAFS2	Peak, Instantaneous	0	0.161	0.130	0.125
		30-minute	0	0.053	0.036	0.043
		60-minute	0	0.026	0.018	0.021
	CCAFS3	Peak, Instantaneous	0	0.466	1.051	0.436
		30-minute	0	0.047	0.089	0.044

TABLE 4.10-2
Maximum Downwind Concentrations for Nominal Atlas V Launches at CCAFS

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
		60-minute	0	0.024	0.045	0.022
	CCAFS4	Peak, Instantaneous	0	0	0.037	0
		30-minute	0	0	0.013	0
		60-minute	0	0	0.006	0

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table 4.10-3.
[d]Proposed medium-lift vehicles with solid rocket motors.

TABLE 4.10-3
Maximum Downwind Concentrations for Atlas V Launch Failures at CCAFS

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	2.08[c]
		60-minute	0	0	0	NA
Atlas V Heavy	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	3.91[c]
		60-minute	0	0	0	NA
Atlas V 551/552[d]	CCAFS1	Peak, Instantaneous	0.0	0.540	0.780	1.607
		30-minute	0.0	0.162	0.235	0.397
		60-minute	0.0	0.081	0.118	0.198
	CCAFS2	Peak, Instantaneous	0.0	9.905	16.321	1.490
		30-minute	0.0	1.059	2.454	0.283
		60-minute	0.0	0.530	1.227	0.142
	CCAFS3	Peak, Instantaneous	0	0.435	1.066	3.020
		30-minute	0	0.077	0.196	0.314
		60-minute	0	0.038	0.098	0.157
	CCAFS4	Peak, Instantaneous	0	13.776	19.823	2.041
		30-minute	0	1.594	2.514	0.241
		60-minute	0	0.797	1.257	0.121

[a] Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table J-28.
[d]Proposed medium-lift vehicles with solid rocket motors.
NA = Not Available in the 1998 FEIS.

TABLE 4.10-4
Concentrations of Emissions of Atlas V 551/552 MLVs with SRMs at CCAFS Compared to Standards

Pollutant	Averaging Time	Concentration	Applicable Standard	Concentration
Nominal Launches				
CO	1-hour	0.025ppm	NAAQS	9 ppm
HCl	1-hour	0.030 ppm	HQ AFSPC/SG	2ppm
HCl	Peak, Instantaneous	0.466 ppm	HQ AFSPC/SG	10 ppm
NO_x	1-hour	0.0 ppm	HQ AFSPC/SG	0.2ppm
PM_{10}[a]	24-hour	1.875 $\mu g/m^3$	NAAQS/FAAQS	150 $\mu g/m^3$
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO[b]	8-hour	0.0248 ppm	NIOSH	35 ppm
HCl	1-hour	0.797 ppm	HQ AFSPC/SG	2ppm
HCl	Peak, Instantaneous	13.776 ppm	HQ AFSPC/SG	10 ppm
NO_x	1-hour	0.0ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[c]	8-hour	0.157 mg/m^3	Federal OSHA	5 mg/m^3

[a]Atlas V 551/552 nominal launch, CCAFS3 (note: 0.045 mg/m^3*1,000µg/mg*1/24 = 1.875$\mu g/m^3$).
[b]Atlas V 551/552 launch failure, CCAFS1 (note: 0.198 ppm*1/8 = 0.0248 ppm).
[c]Atlas V 551/552 launch failure, CCAFS4 (note: 1.257 mg/m^3*1/8 = 0.157 mg/m^3).
FAAQS = Florida Ambient Air Quality Standards.
MLV = Medium-lift vehicle.
NAAQS =National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
SRMs = Solid rocket motors.
HQ AFSPC/SG = Head Quarters Air Force Space Command/Surgeon General
OSHA = Occupational Safety and Health Administration.

4.10.1.1.2 Delta IV System

The emissions associated with proposed Delta IV operations at CCAFS are described in the following paragraphs. Table 4.10-5 shows the Delta IV launch emissions for CCAFS. For the purpose of this analysis, emissions were calculated using the GTO. For emissions into the lower atmosphere, the differences between trajectories were not sufficient to warrant separate analyses.

TABLE 4.10-5
Delta IV System CCAFS Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x[a]	CO	SO_2	PM_{10}[b]	HCl[c]
Delta IV M	0	0.53	0	0	0	0
Delta IV M+ (5,4)[d]	0	0.71	0.0054	0	10.	5.1
Delta IV H	0	1.6	0	0	0	0

[a]Mass assumes all nitrogen oxide oxidized to nitrogen dioxide.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.
Proposed MLVs with SRMs.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

For the Delta IV M+ vehicles, the upper bound case of four solid rocket motors was used. Consequently, they are designated as Delta IV M+ (5,4). The SRMs with the Proposed Action are larger than those described in the 1998 FEIS. As a result, new launch emission calculations were conducted. The new emissions were determined using the methods described in the previous section. For the Delta IV M and Delta IV H vehicles, launch emission estimates from the 1998 FEIS are presented for comparison purposes.

Tables 4.10-6 and 4.10-7 show the estimated, maximum downwind concentrations for the Delta IV nominal launch and launch failure scenarios at CCAFS, respectively. For the Delta IV M+ (5,4) vehicle, new REEDM runs were conducted (as described above) to estimate the downwind concentrations assuming four larger solid rocket motors. For the Delta IV M and Delta IV H vehicles, the down-range concentrations from the 1998 FEIS were used for purposes of comparison. Details of the inputs, assumptions, and model results are provided in Appendix J of the 1998 FEIS.

TABLE 4.10-6
Maximum Downwind Concentrations for Nominal Delta IV Launches at CCAFS

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Delta IV M	1998 FEIS case	30-minute	0.022[c]	0.0	0.0	0
Delta IV H	1998 FEIS case	30-minute	0.012[c]	0.0	0.0	0
Delta IV M+ (5,4)[d]	CCAFS1	Peak, Instantaneous	0	0.156	0.255	0.116
		30-minute	0	0.038	0.046	0.028
		60-minute	0	0.019	0.023	0.014
	CCAFS2	Peak, Instantaneous	0	0.113	0.092	0.077
		30-minute	0	0.036	0.023	0.026
		60-minute	0	0.018	0.012	0.013
	CCAFS3	Peak, Instantaneous	0	0.634	0.996	0.393
		30-minute	0	0.058	0.080	0.036
		60-minute	0	0.029	0.040	0.018
	CCAFS4	Peak, Instantaneous	0	0	0.035	0
		30-minute	0	0	0.009	0
		60-minute	0	0	0.005	0

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table 4.10-13.
[d]Proposed medium-lift vehicles (MLVs) with solid rocket motors (SRMs).
H = Heavy-lift vehicle.
M = MLV.
M+ = MLV with SRMs.

TABLE 4.10-7
Maximum Downwind Concentrations for Delta IV Launch Failures at CCAFS

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Delta IV M	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV H	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV M+ (5,4)[c]	CCAFS1	Peak, Instantaneous	0.0	0.413	0.545	0.683
		30-minute	0.0	0.120	0.145	0.199
		60-minute	0.0	0.060	0.072	0.100
	CCAFS2	Peak, Instantaneous	0.0	14.591	24.177	24.076
		30-minute	0.0	1.255	3.252	2.079
		60-minute	0.0	0.628	1.626	1.040
	CCAFS3	Peak, Instantaneous	0	0.453	0.918	0.750
		30-minute	0	0.074	0.152	0.122
		60-minute	0	0.037	0.076	0.061
	CCAFS4	Peak, Instantaneous	0	20.124	30.003	33.408
		30-minute	0	1.907	3.222	3.166
		60-minute	0	0.953	1.611	1.583

[a] Sum of HCl, Cl_2, and ClO.
[b] Sum of all solid exhaust species.
[c] Proposed medium-lift vehicles (MLVs) with solid rocket motors (SRMs).
H = Heavy-lift vehicle.
M = MLV.
M+ = MLV with SRMs.

Table 4.10-8 compares the estimated, maximum, modeled concentrations for the MLVs with SRMs to the applicable standards. Multiplying the 1-hour Al_2O_3 concentration by 1,000 (to convert from milligrams to micrograms), and then dividing by 24 determined the 24-hour PM_{10} concentration. Also, dividing the 1-hour CO and 1-hour Al_2O_3 concentrations for launch failures by 8 determined the 8-hour CO and 8-hour Al_2O_3 concentration. With the exception of HCl in some launch failure scenarios, all of the estimated, maximum, modeled concentrations are less than the corresponding standards. For cases CCAFS2 and CCAFS4, the HCl peak concentration exceeds the exposure criteria recommended by HQ AFSPC/SG. As discussed in Sections 3.7 and 4.7, launch decisions, however, are not based directly on REEDM predictions, but rather on the results of probabilistic risk predictions. Thus, depending on the details of a launch, REEDM predictions of HCI concentrations that exceed the exposure criteria recommended by the HQ AFSPC/SG may or may not cause a launch to be delayed (see Sections 3.7 and 4.7 for detailed discussion of launch commit criteria).

TABLE 4.10-8
Concentrations of Emissions of Delta IV M+ (5,4) Medium-Lift Vehicles with Solid Rocket Motors at CCAFS Compared to Standards

		Nominal Launches		
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hr	0.018ppm	NAAQS/FAAQS	9 ppm
HCl	1-hour	0.029ppm	HQ AFSPC/SG	2 ppm
HCl	Peak, Instantaneous	0.634 ppm	HQ AFSPC/SG	10 ppm
NO_X	1-hour	0.0ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[a]	24-hour	1.67 μg/m³	NAAQS/FAAQS	150 μg/m³
		Launch Failures		
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO[b]	8-hour	0.198 ppm	NIOSH	35 ppm
HCl	1-hour	0.953ppm	HQ AFSPC/SG	2 ppm
HCl	Peak, Instantaneous	20.124 ppm	HQ AFSPC/SG	10 ppm
NO_X	1-hour	0.0ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[c]	8-hour	0.203 mg/m³	Federal OSHA	5 mg/m³

[a]Delta IV M+(5,4) nominal launch, CCAFS3 (note: 0.040mg/m³*1000μg/mg*1/24 = 1.67μg/m³)
[b]Delta IV M+(5,4) launch failure, CCAFS4 (note: 1.583 ppm*1/8 = 0.198 ppm)
[c]Delta IV M+(5,4) launch failure, CCAFS2 (note: 1.626 mg/m³*1/8 = 0.203 mg/m³)
FAAQS = Florida Ambient Air Quality Standards.
NAAQS =National Ambient Air Quality Standards.
HQ AFSPC/SG = Head Quarters Air Force Space Command/Surgeon General
NIOSH = National Institute for Occupational Safety and Health.
OSHA = Occupational Safety and Health Administration.

4.10.1.2 Vandenberg AFB

4.10.1.2.1 Atlas V System

The emissions associated with proposed Atlas V operations at Vandenberg AFB are described in the following paragraphs. Table 4.10-9 shows the Atlas V launch emissions for Vandenberg AFB. For the purpose of this analysis, emissions were calculated using the low earth orbit (LEO). For emissions into the lower atmosphere the differences between trajectories were not sufficient to warrant separate analyses.

TABLE 4.10-9
Atlas V Vandenberg AFB Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x[a]	CO	SO_2	PM_{10}[b]	HCl[c]
Atlas V 300/400	0	0.42	0	0	0	0
Atlas V 551/552[d]	0	1.1	0.01	0	15	7.8
Atlas V Heavy	0	1.2	0	0	0	0

[a]Mass assumes that all NO_x is NO_2.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.
[d]Proposed medium-lift vehicles with solid rocket motors.

The emissions are the same as those for CCAFS because the flight times through the lowest 3,000 feet are approximately the same.

As described above, the REEDM model was used to determine the down-range pollutant concentrations for the Atlas V 551/552 launch vehicle, assuming the bounding case of five SRMs. For Vandenberg AFB, three meteorological cases were investigated: VAFB1, VAFB2, and VAFB3. The rawinsonde data files for these cases were chosen as representative of conditions at the launch site.

For case VAFB1, the rawinsonde data file is from an October 1997 last afternoon sounding taken in association with a Titan launch. The profile exhibits a neutral stability surface layer extending from the ground to the base of a well-defined elevated temperature inversion at 3,150 feet above the ground. Winds are from the northwest, moderate in speed with little directional shear. Measured turbulence values for the first 400 meters of the surface layer are included.

For case VAFB2, the rawinsonde data file is from a December 20, 1996, late morning sounding taken in association with a Titan launch. A neutral surface layer from the ground to the base of a very weak mid-level inversion based at 1,500 feet above the ground is characterized by very light winds. A wind direction shear zone exists across the weak inversion. Above the inversion winds are from the northwest, light to moderate in speed and with less directional shear. Turbulence measurements are included.

For case VAFB3, the rawinsonde data file is from a May 12, 1996, afternoon sounding taken in association with a Titan launch. Winds are light to moderate in the surface layer, which extends from the ground to the base of a strong, low level inversion at 650 feet above the ground. The potential temperature increases by 10 degrees Celsius across 400 feet of the inversion indicating a very stable layer of air. Measured turbulence is not included; hence REEDM uses an empirical and theoretical climatological turbulence model in place of the missing measured turbulence values. As with CCAFS, the nominal launch and launch failure scenarios were investigated for each meteorological case. Tables 4.10-10 and 4.10-11 show the maximum downwind concentrations from the proposed Atlas V nominal launch and launch failure scenarios at Vandenberg AFB, respectively. Details of the inputs, assumptions, and model results are provided in Appendix T for the FSEIS calculations, and Appendix J for vehicle versions analyzed in the FEIS.

TABLE 4.10-10
Maximum Downwind Concentrations for Atlas V Nominal Launches at Vandenberg AFB

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS case	60-minute	0.013[c]	0	0	0
Atlas V Heavy	1998 FEIS case	60-minute	0.025[c]	0	0	0
Atlas V 551/552[d]	VAFB1	Peak, Instantaneous	0.0	1.896	2.694	1.463
		30-minute	0.0	0.067	0.116	0.052
		60-minute	0.0	0.033	0.058	0.026

TABLE 4.10-10
Maximum Downwind Concentrations for Atlas V Nominal Launches at Vandenberg AFB

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
	VAFB2	Peak, Instantaneous	0.0	0.0	2.267	0
		30-minute	0.0	0.0	0.316	0
		60-minute	0.0	0.0	0.158	0
	VAFB3	Peak, Instantaneous	0	0	5.401	0
		30-minute	0.00	0	0.501	0
		60-minute	0.00	0	0.251	0

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table 4.10-3.
[d] Proposed medium-lift vehicle with solid rocket motors.

TABLE 4.10-11
Maximum Downwind Concentrations from Atlas V Launch Failures at Vandenberg AFB

Launch vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/ m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	2.08[c]
		60-minute	0	0	0	NA
Atlas V Heavy	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	3.91[c]
		60-minute	0	0	0	NA
Atlas V 551/552[d]	VAFB1	Peak, Instantaneous	0	2.053	3.487	10.80
		30-minute	0	0.213	0.465	0.416
		60-minute	0	0.107	0.233	0.208
	VAFB2	Peak, Instantaneous	0	1.312	3.583	0.198
		30-minute	0	0.490	1.391	0.074
		60-minute	0	0.245	0.697	0.037
	VAFB3	Peak, Instantaneous	0	4.017	16.570	0.603
		30-minute	0	0.622	3.226	0.093
		60-minute	0	0.311	1.613	0.047

[a] Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table J-28.
[d]Proposed medium-lift vehicle with solid rocket motors.
NA = Not Available in the 1998 FEIS.

Table 4.10-12 compares the estimated, maximum modeled concentrations of emissions from Atlas V MLVs with SRMs to the applicable standards. Multiplying the 1-hour Al_2O_3 concentration by 1,000 (to convert from milligrams to micrograms), and then dividing by 24 determined the 24-hour PM_{10} concentration. Also, dividing the 1-hour CO and 1-hour Al_2O_3 concentrations for launch failures by 8 determined the 8-hour CO and 8-hour Al_2O_3 concentrations. All of the predicted concentrations are less than the corresponding standards.

TABLE 4.10-12
Concentrations of Emissions of Atlas V 551/552 Medium Lift Vehicles with Solid Rocket Motors at Vandenberg AFB Compared to Standards

Pollutant	Averaging Time	Concentration	Applicable Standard	Concentration
Nominal Launches				
CO	1-hr	0.026 ppm	NAAQS	9 ppm
HCl	1-hour	0.033 ppm	HQ AFSPC/SG	2 ppm
HCl	Peak, Instantaneous	1.896 ppm	HQ AFSPC/SG	10 ppm
NO_x	1-hour	0 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[a]	24-hour	10.46 $\mu g/m^{3a}$	CAAQS	50 $\mu g/m^3$
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO[b]	8-hour	0.026 ppm	NIOSH	35 ppm
HCl	1-hour	0.311 ppm	HQ AFSPC/SG	2 ppm
HCl	Peak, Instantaneous	4.017 ppm	HQ AFSPC/SG	10 ppm
NO_x	1-hour	0ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[c]	8-hour	0.202 mg/m^3	Federal OSHA/California OSHA	5 mg/m^3

[a]Atlas V 551/552 nominal launch, VAFB2 (note: 0.251 mg/m^3*1,000 $\mu g/mg$ * 1/24=10.46 $\mu g/m^3$).
[b]Atlas V 551/552 launch failure, VAFB1 (note: 0.208 ppm*1/8 = 0.026 ppm).
[c]Atlas V 551/552 launch failure, VAFB3 (note: 1.613 mg/m^3*1/8 = 0.202 mg/m^3).
CAAQS = California Ambient Air Quality Standards.
NAAQS =National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG = Headquarters Air Force Space Command/Surgeon General.
OSHA = Occupational Safety and Health Administration.

For several reasons, the reported emissions and concentrations are not always proportional to the size of the vehicle. First, in the case of concentrations, while a larger vehicle using the same fuel may release more HCl, it also releases more water, CO_2, and nitrogen (N_2). Consequently, the larger amounts of these gases dilute the larger amount of HCl, so the concentration of the HCl for the larger and smaller vehicles can be similar. In addition, a larger vehicle produces more heat from combustion of more propellants, so the exhaust cloud may rise higher, lowering concentrations at the ground, assuming the exhaust clouds are the same size (see Appendix T for a discussion of the REEDM model and the assumptions used for these calculations). Finally, a larger vehicle could accelerate to above

3,000 feet altitude more quickly, actually releasing a smaller amount of pollutants near the ground.

4.10.1.2.2 Delta IV System

The emissions associated with proposed Delta IV operations at Vandenberg AFB are discussed in the following paragraphs. Table 4.10-13 shows the Delta IV launch emissions for Vandenberg AFB. For the purpose of this analysis, emissions were calculated using the LEO trajectory. For emissions into the lower atmosphere the differences between trajectories were not sufficient to warrant separate analyses.

TABLE 4.10-13
Delta IV Vandenberg AFB Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x [a]	CO	SO_2	PM_{10} [b]	HCl [c]
Delta IV M	0	0.53	0	0	0	0
Delta IV M+ (5,4)[d]	0	0.71	0.0054	0	10.0	5.1
Delta IV H	0	1.6	0	0	0	0

[a]Mass assumes that all NO_x is NO_2.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.
[d]Proposed medium-lift vehicle with solid rocket motors.
H = Heavy-lift vehicle.
M+ = MLV with SRMs.

As described above, the REEDM model was used to estimate the downwind pollutant concentrations. For the Delta IV M+(5,4) vehicle, new REEDM runs were conducted to estimate the downwind concentrations assuming that four SRMs were used. The three meteorological cases were run for both the nominal launch and launch-failure scenarios. Details of the inputs, assumptions, and model results are provided in Appendix T.

Tables 4.10-14 and 4.10-15 show the estimated, maximum downwind concentrations from the Delta IV nominal launch and launch failure scenarios at Vandenberg AFB, respectively.

TABLE 4.10-14
Maximum Downwind Concentrations from Delta IV Nominal Launches at Vandenberg AFB

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Delta IV M	1998 FEIS case	30-minute	0.022[c]	0.0	0.0	NA
Delta IV H	1998 FEIS case	30-minute	0.012[c]	0.0	0.0	NA
Delta IV M+ (5,4)	VAFB1	Peak, Instantaneous	0	1.270	1.779	0.853
		30-minute	0	0.045	0.077	0.030
		60-minute	0	0.023	0.039	0.015
	VAFB2	Peak, Instantaneous	0	0	2.729	0
		30-minute	0	0	0.314	0
		60-minute	0	0	0.157	0

TABLE 4.10-14
Maximum Downwind Concentrations from Delta IV Nominal Launches at Vandenberg AFB

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
	VAFB3	Peak, Instantaneous	0	0	13.499	0
		30-minute	0	0	0.722	0
		60-minute	0	0	0.361	0

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table 4.10-13.

TABLE 4.10-15
Maximum Downwind Concentrations from Delta IV Launch Failures at Vandenberg AFB

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/ m^3)	CO (ppm)
Delta IV M	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV H	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV M+ (5,4)	VAFB1	Peak, Instantaneous	0	1.378	2.261	2.273
		30-minute	0	0.132	0.280	0.218
		60-minute	0	0.066	0.140	0.109
	VAFB2	Peak, Instantaneous	0	3.399	6.796	5.660
		30-minute	0	0.958	2.074	1.596
		60-minute	0	0.479	1.037	0.798
	VAFB3	Peak, Instantaneous	0	4.777	21.088	7.919
		30-minute	0	0.550	3.325	0.911
		60-minute	0	0.275	1.663	0.456

[a] Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.

Table 4.10-16 compares the estimated, maximum modeled concentrations of emissions from Delta IV MLVs with SRMs to applicable standards. Multiplying the 1-hour Al_2O_3 concentration by 1,000 (to convert from milligrams to micrograms), and then dividing by 24 determined the 24-hour PM_{10} concentration. Also, dividing the 1-hour CO and 1-hour Al_2O_3

concentrations for launch failures by 8 determined the 8-hour CO and 8-hour Al_2O_3 concentration. All of the predicted concentrations are less than the corresponding standards.

TABLE 4.10-16
Concentrations of Emissions of Delta IV M+ (5,4) Medium-Lift Vehicles with Solid Rocket Motors at Vandenberg AFB Compared to Standards

Nominal Launches				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hour	0.015 ppm	NAAQS	9 ppm
HCl	1-hour	0.023ppm	HQ AFSPC/AG	2 ppm
HCl	Peak, Instantaneous	1.270 ppm	HQ AFSPC/AG	10 ppm
NO_X	1-hour	0 ppm	HQ AFSPC/AG	0.2 ppm
PM_{10}[a]	24-hour	15.04 $\mu g/m^3$[a]	CAAQS	50 $\mu g/m^3$
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO[b]	8-hour	0.0998 ppm	NIOSH	35 ppm
HCl	1-hour	0.479 ppm	HQ AFSPC/SG	2 ppm
HCl	Peak, Instantaneous	4.777 ppm	HQ AFSPC/SG	10 ppm
NO_X	1-hour	0ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}[c]	8-hour	0.208 mg/m^3	Federal OSHA/California OSHA	5 mg/m^3

[a]Delta IV M+ (5,4) nominal launch, VAFB3 inversion (note: 0.361 mg/m^3 * 1,000 $\mu g/mg$ * 1/24 = 15.04$\mu g/m^3$).
[b]Delta IV M+ (5,4) launch failure, VAFB2 (note: 0.798 ppm*1/8 = 0.0998 ppm)
[c]Delta IV M+ (5,4) launch failure, VAFB3 (note: 1.663 mg/m^3*1/8 = 0.208 mg/m^3)
CAAQS = California Ambient Air Quality Standards.
NAAQS = National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG = Head Quarters Air Force Space Program Command/Surgeon General
OSHA = Occupational Safety and Health Administration.

4.10.1.3 Combined Impacts of the Proposed Action

Regional impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region.

4.10.1.3.1 CCAFS

This section describes the combined emissions associated with the Proposed Action at CCAFS.

Launch-Related Activities

Table 4.10-17 shows the emissions estimates for yearly launch operations and related activities at CCAFS from 2001 to 2020 for the Proposed Action. For launch vehicles, emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 4.11, Air Quality (Upper Atmosphere). The emission estimates include infrastructure and launch-related emissions sources using the same methods as outlined in the 1998 FEIS. These emission estimates include emissions from the launch vehicles; from activities associated with the preparation, assembly, and fueling of the vehicles; from mobile sources such as support equipment,

commercial transport vehicles (including trucks and aircraft), and personal vehicles; and from point sources such as heating/power plants, generators, incinerators, and storage tanks. The relevant emission factors from the 1998 FEIS were used. It is expected that peak-year emissions at CCAFS of criteria pollutants would not jeopardize the attainment status of these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year emissions are only a small fraction (less than one percent) of the county baseline.

Because additional resources are required for the Atlas V 500 variant, the project site, point source, and mobile source emissions were scaled up from the Atlas V 300/400 factors using the ratio of the Delta IV M to Delta IV M+ launch vehicle emissions.

It is expected that peak-year emissions at CCAFS of criteria pollutants would not jeopardize the attainment status of these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year emissions are only a small fraction (less than one percent) of the county baseline.

Facility Construction

Changes in the construction activities at CCAFS were outlined in Section 2.0. These changes represent minor additions to the No-Action construction activities and depict negligible emissions. No other major construction programs are expected to occur in the vicinity of CCAFS that would cause major emissions of criteria pollutants.

Therefore, cumulative construction emissions from the Proposed Action at CCAFS would not be significant.

4.10.1.3.2 Vandenberg AFB

This subsection describes the combined emissions associated with the Proposed Action at Vandenberg AFB.

Launch-Related Activities

Table 4.10-18 shows the emissions estimates for yearly launch operations and related activities at Vandenberg AFB from 2001 to 2020 for the Proposed Action.

For launch vehicles, emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 4.11, Air Quality (Upper Atmosphere). The emission estimates include infrastructure and launch-related emissions sources using the same methods as outlined in the 1998 FEIS.

These emission estimates include emissions from:

- Launch vehicles
- Activities associated with the preparation, assembly, and fueling of the vehicles
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators, and storage tanks

TABLE 4.10-17
Cumulative Emissions from EELV Activities at CCAFS (Including Proposed Action)

Launch Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
VOC Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.7	7.8	14.1	21.9	20.0	21.9	19.9	20.7	19.2	21.4	21.4	19.9	22.0	20.7	22.9	19.9	20.7	21.4	19.9	21.4
Project Mobile Sources	12.6	12.6	12.7	13.0	12.6	12.5	12.3	12.3	12.1	12.1	12.0	11.8	12.0	11.8	11.9	11.8	11.8	11.8	11.7	11.8
Project Point Sources	0.8	0.9	0.9	1.0	0.9	1.0	1.0	0.9	0.9	1.0	1.0	1.0	1.0	0.9	1.0	1.0	0.9	1.0	1.0	1.0
Project Total	**14.1**	**21.3**	**27.7**	**35.9**	**33.6**	**35.4**	**33.1**	**33.9**	**32.2**	**34.4**	**34.3**	**32.7**	**34.9**	**33.4**	**35.7**	**32.6**	**33.4**	**34.1**	**32.6**	**34.1**
NOx Emissions (tons)																				
Project Launches	0.7	8.0	14.7	22.8	19.9	21.9	21.1	20.8	19.5	22.4	22.4	21.1	23.9	20.8	23.6	21.1	20.8	22.4	21.1	22.4
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	19.9	20.5	21.2	22.1	21.5	21.5	21.3	21.1	20.8	21.1	21.0	20.8	21.1	20.7	21.0	20.7	20.7	20.9	20.7	20.8
Project Point Sources	9.1	10.8	13.0	14.7	13.4	14.7	13.8	13.4	13.4	13.8	13.8	13.8	14.2	13.4	13.8	13.8	13.4	13.8	13.8	13.8
Project Total	**29.7**	**39.3**	**48.9**	**59.5**	**54.8**	**58.2**	**56.2**	**55.3**	**53.8**	**57.3**	**57.2**	**55.7**	**59.3**	**54.8**	**58.5**	**55.6**	**54.8**	**57.0**	**55.6**	**57.0**
CO Emissions (tons)																				
Project Launches	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	89.8	89.6	89.9	91.0	89.0	88.5	87.6	87.4	86.7	86.4	85.7	85.0	85.7	84.9	85.5	84.9	84.9	85.2	84.8	85.2
Project Point Sources	2.1	2.5	3.1	3.6	3.2	3.6	3.3	3.2	3.2	3.3	3.3	3.3	3.4	3.2	3.3	3.3	3.2	3.3	3.3	3.3
Project Total	**91.9**	**92.2**	**93.1**	**94.7**	**92.3**	**92.2**	**91.1**	**90.8**	**90.1**	**89.9**	**89.2**	**88.5**	**89.3**	**88.3**	**89.0**	**88.3**	**88.2**	**88.7**	**88.3**	**88.6**
SO_2 Emission (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Project Point Sources	0.7	0.9	1.2	1.4	1.2	1.4	1.3	1.2	1.2	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.2	1.3	1.3	1.3
Project Total	**1.1**	**1.3**	**1.7**	**1.9**	**1.7**	**1.9**	**1.8**	**1.7**	**1.7**	**1.8**	**1.8**	**1.8**	**1.9**	**1.7**	**1.8**	**1.8**	**1.7**	**1.8**	**1.8**	**1.8**
PM_{10} Emissions (tons)																				
Project Launches	10.0	101.4	152.0	263.3	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4	253.4
Project Preparation, Assembly, & Fueling	0.1	1.9	3.5	5.6	5.3	5.3	5.1	5.3	5.0	5.4	5.4	5.1	5.5	5.3	5.7	5.1	5.3	5.4	5.1	5.4
Project Mobile Sources	53.4	60.8	68.4	77.0	73.7	76.2	74.7	75.1	72.9	76.9	76.9	74.6	78.7	75.1	79.1	74.6	75.1	76.9	74.6	76.9
Project Point Sources	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Project Total	**63.9**	**164.5**	**224.4**	**346.5**	**332.9**	**335.5**	**333.7**	**334.3**	**331.8**	**336.2**	**336.2**	**333.7**	**338.1**	**334.3**	**338.8**	**333.7**	**334.3**	**336.2**	**333.7**	**336.2**

TABLE. 4.10-18
Cumulative Emissions from EELV Activities at Vandenberg AFB (Including Proposed Action)

Launch Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
VOC Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	1.4	4.2	4.2	4.2	4.2	7.0	7.1	6.4	5.6	4.9	6.5	5.6	5.0	4.9	5.6	4.9	6.5	5.6	6.5
Project Mobile Sources	1.1	3.3	3.5	3.5	3.6	3.5	3.6	3.4	3.2	2.9	2.5	2.5	2.3	2.1	2.0	2.1	1.8	1.9	1.8	1.8
Project Point Sources	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Project Total	**1.9**	**5.5**	**8.8**	**8.6**	**8.6**	**8.6**	**11.5**	**11.4**	**10.4**	**9.4**	**8.2**	**9.8**	**8.7**	**8.0**	**7.8**	**8.5**	**7.6**	**9.2**	**8.2**	**9.1**
NOx Emissions (tons)																				
Project Launches	0.0	1.9	4.8	4.8	4.7	5.6	8.9	8.8	7.4	7.6	6.1	7.2	7.7	6.0	6.1	7.6	6.1	7.2	7.7	7.2
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	2.7	8.2	9.0	9.1	9.0	8.9	9.6	9.2	8.4	7.9	7.2	7.3	6.9	6.5	6.2	6.4	5.9	6.1	6.0	6.0
Project Point Sources	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Project Total	**11.4**	**18.8**	**22.6**	**22.6**	**22.3**	**23.2**	**27.2**	**26.7**	**24.5**	**24.2**	**22.0**	**23.3**	**23.3**	**21.2**	**21.0**	**22.7**	**20.7**	**22.1**	**22.4**	**21.9**
CO Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	12.1	36.7	39.0	40.1	40.5	41.4	43.4	41.9	39.9	38.4	36.8	36.0	34.6	33.2	32.1	31.9	31.1	31.1	30.6	30.5
Project Point Sources	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Project Total	**14.0**	**38.7**	**41.0**	**42.1**	**42.5**	**43.4**	**45.5**	**43.9**	**41.9**	**40.5**	**38.9**	**38.1**	**36.6**	**35.3**	**34.1**	**33.9**	**33.1**	**33.1**	**32.6**	**32.5**
SO_2 Emission (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	0.1	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.6	0.7	0.7	0.7
Project Point Sources	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Project Total	**0.8**	**1.0**	**1.1**	**1.2**	**1.2**	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**
PM_{10} Emissions (tons)																				
Project Launches	0.0	25.3	60.6	60.6	50.7	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0
Project Preparation, Assembly, & Fueling	0.0	0.5	1.4	1.4	1.4	1.4	1.9	2.1	1.8	1.8	1.5	2.0	1.6	1.7	1.5	1.8	1.5	2.0	1.6	2.0
Project Mobile Sources	15.6	55.2	70.1	75.4	79.6	85.8	101.3	102.8	97.7	97.4	92.3	99.3	95.8	93.9	92.3	97.4	92.3	99.3	95.8	99.3
Project Point Sources	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Project Total	**16.0**	**81.4**	**132.5**	**137.8**	**132.0**	**163.6**	**179.6**	**181.4**	**176.0**	**175.6**	**170.2**	**177.7**	**173.8**	**172.0**	**170.2**	**175.6**	**170.2**	**177.7**	**173.8**	**177.7**

As described in Section 3.10, Vandenberg AFB is located within an area designated by the EPA as being in "serious" nonattainment of the ozone standard. The EELV program at this location would need to comply with air conformity requirements, as defined in 40 CFR 51 Subpart W, Section 176c of the Clean Air Act (CAA). The conformity rule defines the applicability criteria, including several source exemptions and *de minimus* emission thresholds, which determine whether a federal action in a nonattainment area must conform or is exempt from conforming with the applicable SIP. If the total of indirect and direct emissions of a criteria pollutant in nonattainment exceeds the defined *de minimus* thresholds, or is regionally significant, a formal Air Conformity Determination would be required.

Because Santa Barbara County is in nonattainment for ozone, the applicable *de minimus* threshold levels are for ozone precursors, VOCs and NO_X. The levels are 50 tons per year for each criteria pollutant. For both VOCs and NO_X, the sum of direct and indirect emissions for the Proposed Action is below the *de minimus* threshold level. Furthermore, because VOC and NO_X emissions for the Proposed Action are less than 10 percent of the budgeted emissions of these pollutants under Santa Barbara County's current Clean Air Plan (Santa Barbara County Air Pollution Control District, 1998), these emissions are not regionally significant. The details of these calculations are contained in Appendix S, the conformity applicability analysis.

Facility Construction

Construction activities described in the 1998 FEIS (Section 2.1.1.10 for the Atlas V system and Section 2.1.2.10 for the Delta IV system) would occur under the No-Action Alternative. No additional major construction would be required under the Proposed Action and no other major construction programs are expected to occur in the vicinity of Vandenberg AFB that would cause major emissions of criteria pollutants (see Section 2.4), so cumulative construction emissions from the Proposed Action at Vandenberg AFB would not be significant.

4.10.1.4 Cumulative Impacts

Launches from the EELV program would occur at CCAFS and Vandenberg AFB as launches of other launch vehicles decrease. The cumulative emissions from future launches with the Proposed Action are not expected to exceed the cumulative emissions from previous launches at these two sites.

4.10.2 No-Action Alternative

This section describes the impacts associated with the No-Action Alternative. This alternative will occur whether or not the Proposed Action is implemented.

4.10.2.1 Cape Canaveral Air Force Station

4.10.2.1.1 Atlas V System

The launch emissions associated with No-Action Atlas V operations at CCAFS are described in the following paragraphs. Table 4.10-19 shows the No-Action Alternative Atlas V nominal launch emissions released below 3,000 feet in altitude for CCAFS. The nomenclature in the table has been updated from the 1998 FEIS to reflect current vehicle designations. Because the current Atlas V baseline does not include any variants with hydrazine-fueled upper stages, data related to those variants are not included in these tables but are available in the 1998 FEIS.

TABLE 4.10-19
CCAFS No-Action Atlas V Nominal Launches Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x[a]	CO	SO_2	PM_{10}[b]	HCl[c]
Atlas V 300/400	0	0.42	0	0	0	0
Atlas V Heavy	0	1.2	0	0	0	0

[a]Mass assumes all nitrogen oxide oxidized to nitrogen dioxide.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.

In the No-Action Alternative, the Atlas V system does not include SRMs, so there are no launch vehicle HCl or Al_2O_3 emissions. Tables 4.10-20 and 4.10-21 show the downwind concentrations from nominal launch and launch failure scenarios at CCAFS, respectively. These are the same estimated impacts shown in the 1998 FEIS, and in the previous paragraphs.

TABLE 4.10-20
Maximum Downwind Concentrations for No-Action Atlas V Nominal Launches at CCAFS

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3[b] (mg/m^3)
Atlas V 300/400	1998 FEIS case	60-minute	0.013[c]	0	0
Atlas V Heavy	1998 FEIS case	60-minute	0.025[c]	0	0

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]FEIS Table 4.10-3.

TABLE 4.10-21
Maximum Downwind Concentrations for No-Action Atlas V Launch Failures at CCAFS

Vehicle	Inversion	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3[b] (mg/m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	2.08[c]
		60-minute	0	0	0	NA
Atlas V Heavy	1998 FEIS Case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	3.91[c]
		60-minute	0	0	0	NA

[a] Sum of HCl, Cl_2, and ClO.
[b] Sum of all solid exhaust species.
[c] 1998 FEIS Table J-28.
NA = Not Available in the 1998 FEIS.

Table 4.10-22 compares the estimated, maximum, modeled concentration applicable standards. All the estimated concentrations are less than the standards or PEL ceilings.

TABLE 4.10-22
Concentrations of Emissions of No-Action Atlas V Launch vehicles at CCAFS Compared to Standards

Nominal Launches				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hour	0.0 ppm	NAAQS	9 ppm
HCl	1-hour	0.0 ppm	HQ AFSPC/SG	2 ppm
NO_x	1-hour	0.025 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	24-hour	0.0 μg/m^3	NAAQS/FAAQS	150 μg/m^3
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	8-hour	3.3 ppm	NIOSH	35 ppm
HCl	1-hour	0.0 ppm	HQ AFSPC/SG	2 ppm
NO_x	1-hour	0.114 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	8-hour	0.0 μg/m^3	Federal OSHA	5 mg/m^3

FAAQS = Florida Ambient Air Quality Standards.
NAAQS = National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG = Head Quarters Air Force Space Command/Surgeon General
OSHA = Occupational Safety and Health Administration.

4.10.2.1.2 Delta IV System

The emissions up to a 3,000-foot altitude, associated with the No-Action Alternative Delta IV system at CCAFS, are described in the following paragraphs. Table 4.10-23 shows the Delta IV launch emissions for CCAFS. The launch vehicle categories differ slightly from those presented in the 1998 FEIS, because they have been updated to reflect current vehicle designations. Because the current Delta IV baseline does not include any variants with hydrazine-fueled upper stages, data related to those variants are not included in these tables, but are available in the 1998 FEIS. For the DIV M+ emissions, the configuration with four smaller (GEM 46) SRMs was used in the 1998 FEIS.

TABLE 4.10-23
No-Action Delta IV System CCAFS Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x [a]	CO	SO_2	PM_{10} [b]	HCl [c]
Delta IV M	0	0.53	0	0	0	0
Delta IV M+	0	0.65	0	0	5.9	2.9
Delta IV H	0	1.6	0	0	0	0

[a] Mass assumes that all NO_x is NO_2.
[b] Sum of all solid exhaust species.
[c] Sum of HCl, Cl_2, and ClO.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

Tables 4.10-24 and 4.10-25 show the maximum downwind concentrations from the Delta IV launches at CCAFS.

TABLE 4.10-24
Maximum Downwind Concentrations for No-Action Delta IV Nominal Launches at CCAFS

Vehicle	Meteorological Case	Averaging Time	NO_x (ppm)	HCl[a] (ppm)
Delta IV M	1998 FEIS case	30-minute	0.022[b]	0.0
Delta IV H	1998 FEIS case	30-minute	0.012[b]	0.0
Delta IV M+	1998 FEIS case	30-minute	0.026[a]	0.29

[a]Sum of HCl, Cl_2, and ClO.
[b]1998 FEIS Table 4.10-13.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

TABLE 4.10-25
Maximum Downwind Concentrations for No-Action Delta IV Launch Failures at CCAFS

Vehicle	Inversion	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/ m^3)	CO (ppm)
Delta IV M	1998 FEIS Case	Peak	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV H	1998 FEIS Case	Peak	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV M+	1998 FEIS Case	Peak	0	0.023[c]	NA	NA
		30-minute	0	0.007[c]	NA	0.011[d]
		60-minute	0	0.004[e]	NA	0.006[e]

[a] Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table J-35.
[d]1998 FEIS Table J-33.
[e]Estimated from 30-minute value.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.
NA = Not Available in the 1998 FEIS.

Table 4.10-26 compares the estimated, maximum-modeled concentrations for these launch vehicles to short-term applicable standards. All of the predicted concentrations are less than the standards or PEL ceilings.

4.10.2.2 Vandenberg AFB

4.10.2.2.1 Atlas V System

This subsection describes the emissions associated with the No-Action Atlas V system at Vandenberg AFB. Table 4.10-27 shows the No-Action Atlas V launch emissions for Vandenberg AFB.

TABLE 4.10-26
Concentrations of Emissions of No-Action Delta IV Launch Vehicles at CCAFS Compared to Standards

Pollutant	Averaging Time	Concentration	Applicable Standard	Concentration
Nominal Launches				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hour	0.0 ppm	NAAQS/FAAQS	9 ppm
HCl	1-hour	0.384 ppm	HQ AFSPC/SG	2 ppm
NO_X	1-hour	0.011 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	24-hour	NA	NAAQS/FAAQS	150 $\mu g/m^3$
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	8-hour	0.006 ppm [a]	NIOSH	35 ppm
HCl	1-hour	0.023 ppm [b]	HQ AFSPC/SG	2 ppm
NO_X	1-hour	0.071 ppm [c]	HQ AFSPC/SG	0.2 ppm
PM_{10}	8-hour	NA	Federal OSHA	5 mg/m^3

[a]Estimated from 30-minute value in 1998 FEIS Table J-33.
[b]1998 FEIS Table J-35.
[c]1998 FEIS Table J-34.
NA = Not Available in the 1998 FEIS.
NAAQS = National Ambient Air Quality Standards.
FAAQS = Florida Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG = Head Quarters Air Force Space Program Command/Surgeon General
OSHA = Occupational Safety and Health Administration

TABLE 4.10-27
No-Action Atlas V Vandenberg AFB Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	NO_x [a]	CO	SO_2	PM_{10} [b]	HCl [c]
Atlas V 300/400	0	0.42	0	0	0	0
Atlas V Heavy	0	1.2	0	0	0	0

[a]Mass assumes that all NO_x is NO_2.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.

In the No-Action Alternative, the Atlas V system does not include SRMs, so there are no launch-vehicle-related HCl or Al_2O_3 emissions. Tables 4.10-28 and 4.10-29 show the downwind concentrations from nominal launch and launch failure scenarios at Vandenberg AFB, respectively. These are the same impacts as shown in the 1998 FEIS, and in the previous paragraphs.

Table 4.10-30 compares the estimated, maximum-modeled concentration to applicable standards. All of the predicted concentrations are less than the standards or PEL ceilings.

TABLE 4.10-28
Maximum Downwind Concentrations for No-Action Atlas V Nominal Launches at Vandenberg AFB

Vehicle	Meteorological Case	Averaging Time	NO_X (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)
Atlas V 300/400	1998 FEIS case	60-minute	0.013[c]	0	0
Atlas V Heavy	1998 FEIS case	60-minute	0.025[c]	0	0

[a] Sum of HCl, Cl_2, and ClO.
[b] Sum of all solid exhaust species.
[c] 1998 FEIS Table 4.10-3.

TABLE 4.10-29
Maximum Downwind Concentrations for No-Action Atlas V Launch Failures at Vandenberg AFB

Vehicle	Inversion	Averaging Time	NO_X (ppm)	HCl[a] (ppm)	Al_2O_3 [b] (mg/m^3)	CO (ppm)
Atlas V 300/400	1998 FEIS case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	2.08[c]
		60-minute	0	0	0	NA
Atlas V Heavy	1998 FEIS case	Peak, Instantaneous	0	0	0	NA
		30-minute	0	0	0	3.91[c]
		60-minute	0	0	0	NA

[a] Sum of HCl, Cl_2, and ClO.
[b] Sum of all solid exhaust species.
[c] 1998 FEIS Table J-28.
NA = Not Available in the 1998 FEIS.

TABLE 4.10-30
Concentrations of Emissions of No-Action Atlas Launch vehicles at Vandenberg AFB Compared to Standards

Nominal Launches				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hour	0.0 ppm	NAAQS	9 ppm
HCl	1-hour	0.0 ppm	HQ AFSPC/SG	2 ppm
NO_X	1-hour	0.162 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	24-hour	0 $\mu g/m^3$	CAAQS	50 $\mu g/m^3$
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	8-hour	3.3 ppm	NIOSH	35 ppm
HCl	1-hour	0.0 ppm	HQ AFSPC/SG	2 ppm
NO_X	1-hour	0.114 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	8-hour	0 $\mu g/m^3$	Federal OSHA or California OSHA	5mg/m^3

CAAQS = California Ambient Air Quality Standards.
NAAQS = National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG = Head Quarters Air Force Space Command/Surgeon General.
OSHA = Occupational Safety and Health Administration.

4.10.2.2.2 Delta IV System

The emissions associated with the No-Action Delta IV system at Vandenberg AFB are described in the following paragraphs. Table 4.10-31 shows the Delta IV launch emissions for Vandenberg AFB.

TABLE 4.10-31
No-Action Delta IV Vandenberg AFB Launch Emissions in Lower Atmosphere (tons/launch)

Launch vehicle	VOC	No_X[a]	CO	SO_2	PM_{10}[b]	HCl[c]
Delta IV M	0	0.53	0	0	0	0
Delta IV M+	0	0.65	0	0	5.9	2.9
Delta IV H	0	1.6	0	0	0	0

[a]Mass assumes that all NO_x is NO_2.
[b]Sum of all solid exhaust species.
[c]Sum of HCl, Cl_2, and ClO.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

Tables 4.10-32 and 4.10-33 show the estimated, maximum downwind concentrations from the Delta IV nominal launch and launch failure scenarios at Vandenberg AFB, respectively. These runs show the same general trends as seen in the No-Action Alternative Atlas V cases. In two of the launch failure cases, the cloud rises above the inversion, which results in no ground-level impacts.

TABLE 4.10-32
Maximum Downwind Concentrations for No-Action Delta IV Nominal Launches at Vandenberg AFB

Vehicle	Meteorological Case	Averaging Time	NO_X (ppm)	HCl[a] (ppm)	Al_2O_3[b] (mg/m^3)
Delta IV M	1998 FEIS case	Peak, Instantaneous	0.109[c]	0.0	0.0
Delta IV H	1998 FEIS case	Peak, Instantaneous	0.020[c]	0.0	0.0
Delta IV M+	1998 FEIS case	Peak, Instantaneous	0.119[c]	0.293[d]	NA

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table 4.10-18.
[d]1998 FEIS Table 4.10-13.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

Table 4.10-34 compares the estimated, maximum-modeled concentrations to applicable standards. All of the predicted concentrations are less than the standards or PEL ceilings.

4.10.2.3 Cumulative Impacts

Regional impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region.

TABLE 4.10-33
Maximum Downwind Concentrations for No-Action Delta IV Launch Failures at Vandenberg AFB

Vehicle	Inversion	Averaging Time	NO_x (ppm)	HCl[a] (ppm)	Al_2O_3[b] (mg/ m^3)	CO (ppm)
Delta IV M	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV H	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	0	0	0	0
		60-minute	0	0	0	0
Delta IV M+	1998 FEIS Case	Peak, Instantaneous	0	0	0	0
		30-minute	NA	NA	NA	0.011[c]
		60-minute	NA	NA	NA	NA

[a]Sum of HCl, Cl_2, and ClO.
[b]Sum of all solid exhaust species.
[c]1998 FEIS Table J-33.
H = Heavy-lift vehicle.
M = Medium-lift vehicle (MLV).
M+ = MLV with solid rocket motors.

TABLE 4.10-34
Concentrations of Emissions of No-Action Delta IV Launch vehicles at Vandenberg AFB Compared to Standards

Nominal Launches				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	1-hr	0.0 ppm	NAAQS	9 ppm
HCl	1-hour	1.12 ppm	HQ AFSPC/SG	2 ppm
NO_x	1-hour	0.002 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	24-hour	NA	CAAQS	50 µg/m^3
Launch Failures				
Pollutant	**Averaging Time**	**Concentration**	**Applicable Standard**	**Concentration**
CO	8-hour	3.3 ppm	NIOSH	35 ppm
HCl	1-hour	0.119 ppm	HQ AFSPC/SG	2 ppm
NO_X	1-hour	0.227 ppm	HQ AFSPC/SG	0.2 ppm
PM_{10}	8-hour	NA	Federal OSHA or California OSHA	5 mg/m^3

CAAQS = California Ambient Air Quality Standards.
NA = Not Available in the 1998 FEIS.
NAAQS = National Ambient Air Quality Standards.
NIOSH = National Institute for Occupational Safety and Health.
HQ AFSPC/SG =Head Quarters Air Force Space Command/Surgeon General
OSHA = Occupational Safety and Health Administration.

4.10.2.3.1 Cape Canaveral Air Force Station

This section describes the emissions associated with No-Action Alternative launch operations at CCAFS.

Launch-Related Activities

Table 4.10-35 shows the emissions estimates for yearly launch operations and related activities at CCAFS from 2001 to 2020 for the entire EELV program under the No-Action Alternative. For launch vehicles, emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 4.11, Air Quality (Upper Atmosphere). The emissions estimates include infrastructure and launch-related emissions sources, using the same methods as outlined in the 1998 FEIS and using the relevant emission factors from the 1998 FEIS. These emissions estimates include emissions from:

- Launch vehicles
- Activities associated with the preparation, assembly, and fueling of the vehicles
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators, and storage tanks

Facility Construction

Under the No-Action Alternative, construction activities at CCAFS are as described in the 1998 FEIS. As a result of no change in construction activities, cumulative impacts would not occur.

4.10.2.3.2 Vandenberg AFB

This section describes the emissions associated with No-Action Alternative launch operations associated with SRMs that, in combination with other activities at Vandenberg AFB, would result in cumulative impacts to air quality in the lower atmosphere.

Launch-Related Activities

Table 4.10-36 shows the emissions estimates for yearly launch operations and related activities at Vandenberg AFB from 2001 to 2020 under the No-Action Alternative.

For launch vehicles, emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 4.11, Air Quality (Upper Atmosphere). The emissions estimates include infrastructure and launch-related emissions sources using the same methods as outlined in the 1998 FEIS. These emission estimates include emissions from:

- Launch vehicles
- Activities associated with the preparation, assembly, and fueling of the vehicles
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators, and storage tanks

Facility Construction

Under the No-Action Alternative, construction activities at Vandenberg AFB are as described in the 1998 FEIS. As a result of no change in construction activities, cumulative impacts would not occur.

4.11 Air Quality (Upper Atmosphere)

This section describes air quality resources for the atmosphere above an altitude of 3,000 feet that may be affected by the Proposed Action and the No-Action Alternative. The analysis is divided into local impacts based on launch system and global, cumulative impacts.

4.11.1 Atlas V System

For the purposes of the atmospheric emissions analyses, the vehicle configuration with five SRMs was assumed to represent the upper bound. Computer model calculations were used to estimate the deposition rate of various chemical species in the wake of the launch vehicle. The emissions for the core vehicle and the SRMs were calculated separately. Representative trajectories were provided by LMC. The flight travel times through the layers of the atmosphere are shown in Table 4.11-1 for the LEO and GTO trajectories for the Atlas V 551/552 vehicle.

The Joint Army-Navy-NASA Air Force (JANNAF) Solid Propellant Rocket Motor Performance Computer Program (SPP), Version 6.0 (Nickerson, et al., 1987; Zittel, 1999 a and b) was used to calculate the nozzle emissions from the SRMs, and the Two-Dimensional Kinetics (TDK) Nozzle Performance Code (Nickerson, et al., 1993; Zittel, 1999 a and b) was used for the liquid core calculations. The Standard Plum Flowfield Model (SPF3) Version 4.0 (Taylor and Pergament, 1998; The Aerospace Corporation, 1999), was used to model the plume, including afterburning effects. The deposition quantities reported were obtained by integrating the SPF3 mass flow output over the altitude region of interest; these quantities are shown in Table 4.11-2. Values in the table illustrate emissions from the Atlas V MLVs with five SRMs (the Proposed Action).

Because the LEO and GTO flight times through the atmospheric layers were similar, only the GTO mass depositions have been presented and used in this analysis. At approximately 125,000 feet in altitude, the solid motors would burn out and later would be jettisoned from the vehicle. Therefore, the solid motors would not burn all the way through the stratosphere.

Because of the addition of the five SRMs, the Atlas V 551/552 has the largest potential impact of all of the Atlas V vehicles on the upper atmosphere, especially the stratosphere; therefore, it is the bounding case for this analysis. Table 4.11-3 shows a comparison of the stratospheric emissions of particulate (as alumina) and Cl_x compounds between different U.S. lift vehicles. Cl_x is defined as the total of the HCl, ClO, Cl_2, and Cl species. NO_x emissions were not included in Table 4.11-3 because NO_x emissions tend to be much smaller than the particulate and chlorine emissions.

The Atlas V 551/552 lift vehicle deposits fewer particulate and chlorine compounds into the stratosphere than the Titan IV or the Space Shuttle but more than the smaller vehicles in Table 4.11-3. The quantities of emissions deposited in the stratosphere depend on the altitude reached before the SRM burns out.

TABLE 4.10-35
Cumulative Emissions from EELV No-Action Alternative Activities at CCAFS

Launch Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
VOC Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.7	4.9	6.9	11.9	10.6	14.8	13.4	14.2	12.7	14.8	14.8	13.4	15.5	14.2	16.3	13.4	14.2	14.8	13.4	14.8
Project Mobile Sources	12.6	12.5	12.3	12.5	12.2	12.2	12.1	12.0	11.8	11.8	11.8	11.6	11.7	11.5	11.7	11.5	11.5	11.6	11.5	11.6
Project Point Sources	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Project Total	**14.1**	**18.2**	**20.1**	**25.4**	**23.7**	**28.0**	**26.3**	**27.1**	**25.4**	**27.6**	**27.6**	**25.9**	**28.2**	**26.7**	**29.0**	**25.8**	**26.6**	**27.4**	**25.8**	**27.3**
NO_X Emissions (tons)																				
Project Launches	0.6	3.7	6.2	9.6	7.5	10.9	10.8	10.5	9.2	12.0	12.0	10.8	13.6	10.5	13.3	10.8	10.5	12.0	10.8	12.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	19.9	20.2	20.3	20.9	20.4	20.9	20.7	20.6	20.3	20.6	20.4	20.2	20.6	20.1	20.5	20.1	20.1	20.3	20.1	20.3
Project Point Sources	9.1	10.4	11.7	12.5	11.7	13.0	13.0	12.5	12.5	13.0	13.0	13.0	13.4	12.5	13.0	13.0	12.5	13.0	13.0	13.0
Project Total	**29.7**	**34.3**	**38.2**	**43.1**	**39.6**	**44.7**	**44.4**	**43.6**	**42.0**	**45.6**	**45.4**	**44.0**	**47.6**	**43.1**	**46.7**	**43.9**	**43.1**	**45.3**	**43.9**	**45.3**
CO Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	89.8	89.0	87.9	88.5	86.8	87.2	86.4	86.3	85.6	85.3	84.5	83.9	84.6	83.8	84.4	83.7	83.7	84.1	83.7	84.0
Project Point Sources	2.1	2.4	2.8	3.0	2.8	3.1	3.1	3.0	3.0	3.1	3.1	3.1	3.2	3.0	3.1	3.1	3.0	3.1	3.1	3.1
Project Total	**91.9**	**91.5**	**90.7**	**91.5**	**89.5**	**90.3**	**89.5**	**89.3**	**88.6**	**88.4**	**87.6**	**87.0**	**87.8**	**86.8**	**87.5**	**86.8**	**86.7**	**87.2**	**86.8**	**87.1**
SO_2 Emission (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Project Point Sources	0.7	0.9	1.0	1.1	1.0	1.2	1.2	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.1	1.2	1.2	1.2
Project Total	**1.1**	**1.3**	**1.5**	**1.6**	**1.5**	**1.7**	**1.7**	**1.6**	**1.6**	**1.7**	**1.7**	**1.7**	**1.7**	**1.6**	**1.7**	**1.7**	**1.6**	**1.7**	**1.7**	**1.7**
PM_{10} Emissions (tons)																				
Project Launches	5.9	17.6	11.7	23.4	23.4	29.3	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2
Project Preparation, Assembly, & Fueling	0.1	1.5	1.8	3.7	3.5	4.5	4.2	4.4	4.1	4.5	4.5	4.2	4.6	4.4	4.8	4.2	4.4	4.5	4.2	4.5
Project Mobile Sources	53.4	58.3	61.2	67.1	64.7	69.9	68.9	69.4	67.2	71.2	71.1	68.9	72.9	69.4	73.4	68.9	69.4	71.1	68.9	71.1
Project Point Sources	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.5	0.6	0.6	0.6
Project Total	**59.8**	**77.8**	**75.2**	**94.8**	**92.1**	**104.2**	**108.8**	**109.5**	**106.9**	**111.4**	**111.4**	**108.8**	**113.3**	**109.5**	**113.9**	**108.8**	**109.5**	**111.4**	**108.8**	**111.4**

TABLE 4.10-36
Cumulative Emissions from EELV No-Action Alternative Activities at Vandenberg AFB

Launch Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
VOC Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	2.8	4.2	4.2	4.2	7.0	7.1	6.4	5.6	4.9	6.5	5.6	5.0	4.9	4.9	4.9	5.7	5.6	5.7
Project Mobile Sources	4.1	3.6	3.5	3.2	2.9	2.7	2.5	2.3	2.1	1.8	1.6	1.5	1.5	1.3	1.1	1.2	1.1	1.0	1.0	1.0
Project Point Sources	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Project Total	**5.0**	**4.5**	**7.1**	**8.3**	**7.9**	**7.7**	**10.4**	**10.3**	**9.3**	**8.3**	**7.3**	**8.8**	**7.9**	**7.1**	**6.8**	**6.9**	**6.8**	**7.5**	**7.4**	**7.5**
NOx Emissions (tons)																				
Project Launches	0.0	0.0	2.0	3.1	3.1	3.2	6.5	6.4	5.0	5.2	3.7	4.9	5.3	3.6	3.7	4.8	3.7	4.4	5.3	4.4
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	11.0	10.1	9.9	9.4	8.7	8.1	8.2	7.8	7.2	6.7	6.2	6.2	5.9	5.5	5.3	5.4	5.0	5.1	5.2	4.9
Project Point Sources	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Project Total	**19.6**	**18.8**	**20.6**	**21.2**	**20.5**	**20.0**	**23.4**	**22.9**	**20.8**	**20.6**	**18.6**	**19.7**	**19.9**	**17.8**	**17.7**	**18.8**	**17.5**	**18.2**	**19.2**	**18.0**
CO Emissions (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	49.8	46.6	44.7	42.5	40.0	38.1	37.3	35.9	34.3	33.0	31.7	30.8	29.8	28.5	27.6	27.2	26.7	26.4	26.3	25.9
Project Point Sources	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Project Total	**51.8**	**48.6**	**46.7**	**44.5**	**41.9**	**40.0**	**39.3**	**37.8**	**36.2**	**35.0**	**33.6**	**32.8**	**31.8**	**30.4**	**29.6**	**29.1**	**28.7**	**28.4**	**28.3**	**27.8**
SO_2 Emission (tons)																				
Project Launches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Preparation, Assembly, & Fueling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Mobile Sources	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.5	0.5	0.6	0.5	0.6	0.6	0.6
Project Point Sources	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Project Total	**1.1**	**1.1**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
PM_{10} Emissions (tons)																				
Project Launches	0.0	0.0	5.9	11.7	11.7	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
Project Preparation, Assembly, & Fueling	0.0	0.0	0.9	1.4	1.4	1.4	1.9	2.1	1.8	1.8	1.5	2.0	1.6	1.7	1.5	1.5	1.5	1.7	1.6	1.7
Project Mobile Sources	64.2	64.2	70.1	73.3	73.3	73.6	82.6	82.6	79.0	78.6	75.0	79.1	78.5	75.0	75.0	77.1	75.0	77.6	78.5	77.6
Project Point Sources	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Project Total	**64.6**	**64.6**	**77.3**	**86.8**	**86.8**	**93.0**	**102.5**	**102.8**	**98.8**	**98.4**	**94.4**	**99.1**	**98.1**	**94.7**	**94.4**	**96.6**	**94.4**	**97.3**	**98.1**	**97.3**

TABLE 4.11-1
Flight Trajectory Times for Atlas V 551/552 with Five SRMs

Layer Designation	Layer Elevation (feet)	CCAFS Trajectory (GTO) (seconds)	VAFB Trajectory (LEO) (seconds)
Lower Atmosphere	0 to 3,000	14.5	14.2
Free Troposphere	3,000 to 49,000	84.6	85.2
Stratosphere	49,000 to 164,000	113.4	113.5

GTO = Geosynchronous transfer orbit.
LEO = Low-earth orbit.

TABLE 4.11-2
Summary of Atlas V Flight Emissions into the Upper Atmospheric Layers (tons per launch)

Lift Vehicle/Atmosphere Layer	Particulate[a]	NO_x[b]	Cl_x[c]
Lift Vehicle: Atlas V 300/400			
Free Troposphere	0.0	0.61	0.0
Stratosphere	0.0	0.0035	0.0
Lift Vehicle: Atlas V 551/552			
Free Troposphere	41	0.75	21
Stratosphere	30	0.028	15
Lift Vehicle: Atlas V Heavy			
Free Troposphere	0.0	1.8	0.0
Stratosphere	0.0	0.010	0.0

[a]Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b]NO_x represents the total of NO and a small amount of NO_2.
[c]Cl_x represents the total of HCl, Cl_2, Cl, and ClO.

TABLE 4.11-3
Vehicle Deposition Rates in the Stratosphere for Atlas V 551/552 Compared to Other U.S. Lift Vehicles Using SRMs

Lift Vehicle	Tons per Launch	
	Particulate[a]	Cl_x[b]
Space Shuttle[c]	112	79
Titan IVB w/ SRMs [c]	93	55
Atlas V 551/552	30	15
No-Action Delta IV M+	2	0.9
Atlas II AS[c]	3	5
Delta II[c]	12	8

[a]Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b]Cl_x represents the total of HCl, Cl_2, Cl, and ClO.
[c] Brady, et al., 1994.
M+ = Medium-lift vehicle with solid rocket motors.

In order to compare local stratospheric impacts, the size and duration of a potential ozone hole in the wake of an Atlas V 551/552 lift vehicle was estimated based on the work of Brady and Martin (1995) and Brady, et al. (1997). Table 4.11-4 shows these values compared

to similar estimates for other U.S. lift vehicles. These estimated values are for an altitude of 20 kilometers.

TABLE 4.11-4
Ozone Depletion Time and Hole Size at an Altitude of 20 km for Atlas V 551/552, Compared to Other Lift Vehicles

Lift Vehicle	Chlorine Release Rate (tons/km)	Hole Diameter (km)	Hole Duration (minutes)[a]
Space Shuttle	4.3	5	97
Titan IV	2.0	4	25[a]
Atlas V 551/552	0.65	2	3.6
No-Action Delta IV M+	0.42	2	1.0
Atlas II AS	0.10	0.8	0.1
Delta II	0.30	1	0.9

Source: Brady, et al. (1994), Brady and Martin (1995), and Brady, et al. (1997).
[a] Ross, et al. (1997a), reported 30 minute near total depletion at 18 km in daytime.

For the proposed Atlas V 551/552 lift vehicle, the release rate used the total chlorine mass released from five SRMs. The estimated ozone hole would last a few minutes and would have a limited size. Because the flight trajectory is not vertical, and because wind shears occur, the ground-level UV increase from loss of stratospheric ozone would be less than would be the case if the ozone depletion occurred in a uniform vertical column. This constitutes an insignificant impact to global ozone.

4.11.2 Delta IV System

For the purposes of the atmospheric emissions analyses, the Proposed Action Delta IV lift vehicle configuration with four GEM 60 SRMs was assumed to represent the upper bound. Computer model calculations were used to estimate the deposition rate of various chemical species in the wake of the lift vehicle. The emissions for the core vehicle and the SRMs were calculated separately. Representative trajectories were provided by Boeing. The flight travel times through the layers of the atmosphere are shown in Table 4.11-5 for the LEO and GTO travel times for the Delta IV M+ (5,4) lift vehicle.

TABLE 4.11-5
Flight Trajectory Times for Delta IV M+ (5,4)

Layer Designation	Layer Elevation (feet)	GTO Trajectory (seconds)	LEO Trajectory (seconds)
Lower Atmosphere	0 to 3,000	14.5	13.4
Free Troposphere	3,000 to 49,000	88.0	86.2
Stratosphere	49,000 to 164,000	129.2	126.2

GTO = geosynchronous transfer orbit.
LEO = low-earth orbit.

Because the travel times are similar for both GTO and LEO trajectories, the emissions deposited within the different atmospheric layers are similar. The amount of mass emitted into the upper atmosphere from a GTO launch trajectory (3,000 to 164,000 feet) is shown in Table 4.11-6, including emissions from the Delta IV M+ (5,4) MLVs with four SRMs (the Proposed Action). At approximately 104,000 feet in altitude, the SRMs would finish burning

and would be jettisoned from the vehicle. Therefore, the SRMs would not be burning all the way through the stratosphere.

The Delta IV M+ (5,4) vehicle has the greatest potential impact of all Delta IV vehicles on the upper atmosphere, especially the stratosphere, and is therefore the bounding case for this analysis. Table 4.11-7 shows a comparison of the stratospheric emission of particulate (as alumina) and Cl_x compounds between different lift vehicles. Cl_x is defined as the total of the HCl, ClO, Cl, and Cl_2 species. NO_x emissions were not included in Table 4.11-7 because NO_x emissions tend to be much smaller than the particulate and chlorine emissions.

TABLE 4.11-6
Summary of Delta IV Flight Emissions into Atmospheric Layers (in tons)

Lift Vehicle/ Atmosphere Layer	Particulate[a]	NO_x[b]	Cl_x[c]
Lift Vehicle: Delta IV M			
Free Troposphere	0.0	0.28	0.0
Stratosphere	0.0	0.0035	0.0
Lift Vehicle: Delta IV M+ (5,4)			
Free Troposphere	26	0.49	13
Stratosphere	12	0.014	6
Lift Vehicle: Delta IV H			
Free Troposphere	0.0	0.83	0.0
Stratosphere	0.0	0.010	0.0

[a]Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b]NO_x represents the total of NO and a small amount of NO_2.
[c]Cl_x represents the total of HCl, Cl_2, Cl, and ClO.
H = Heavy-lift vehicle.
M = Medium-lift vehicle.
M+ = MLV with solid rocket motors.

TABLE 4.11-7
Vehicle Deposition Rates in the Stratosphere for Delta IV M+ (5,2) Compared to Other U.S. Lift Vehicles with Solid Rocket Motors

	Tons per launch	
Lift Vehicle	Particulate[a]	Cl_x[b]
Space Shuttle[c]	112	79
Titan IVA w/ SRMUs [c]	93	55
Proposed Delta IV M+ (5,4)	12	6
No-Action Delta IV M+	2	0.9
Atlas II AS[c]	3	5
Delta II[c]	12	8

[a]Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b]Cl_x represents the total of HCl, Cl_2, Cl, and ClO.
[c] Brady, et. al, 1994.
M+ = Medium-lift vehicle with solid rocket motors.

Table 4.11-8 shows the estimated local ozone depletion for the Delta IV M+ (5,4) compared to other U.S. lift vehicles. The estimates were made using the same procedure, as described

in Section 4.11.1 for the Atlas V vehicles. Estimates such as these can vary by several orders of magnitude, depending on the diffusion coefficient used in the calculations. For the proposed Delta IV M+ (5,4) lift vehicle, the release rate was estimated from the total chlorine mass. The hole is estimated to have a duration of less than 2 minutes and to have a limited size. Because the flight trajectory is not vertical, and because wind shears occur, the ground-level UV increase from loss of stratospheric ozone would be less than would be the case if the ozone depletion occurred in a uniform vertical column. This constitutes an insignificant impact to global ozone.

TABLE 4.11-8
Ozone Depletion Time and Hole Size at an Altitude of 20 Kilometers for Delta IV M+ (5,4) with Four SRMs Compared to Other U.S. Lift Vehicles with Solid Rocket Motors

Lift Vehicle	Chlorine Release Rate (tons/km)	Hole Diameter (km)	Hole Duration (minutes)[a]
Shuttle	4.3	10	97
Titan IV	2.0	7	25[a]
Proposed Delta IV M+ (5,4)	0.36	3	1.3
No-Action Delta IV M+	0.42	2	1.0
Atlas II AS	0.10	0.8	0.1
Delta II	0.30	1	0.9

Derived from Brady, et al. (1994), Brady and Martin (1995), and Brady, et al. (1997).
M = Medium-lift vehicle with solid rocket motors.
[a]Ross, et al. (1997a), reported 30-minute near total at 18 km in daytime.

4.11.3 Combined Impacts

The total EELV program emission rates under the Proposed Action were estimated for each year using the launch rates shown in Section 2 and the launch emissions developed in Tables 4.11-2 and 4.11-6. The peak annual launch emissions for the free troposphere and the stratosphere from each launch site and from the two combined are shown in Table 4.11-9.

The release of lift vehicle emissions into the stratosphere from both elements of the Proposed Action could result in combined local and global impacts. In terms of local effects, as discussed above, the passage of a lift vehicle through the stratosphere has been shown to cause a temporary, local decrease in the amount of ozone, a so-called local "hole" in the ozone layer. This reduction in stratospheric ozone along the flight path of the lift vehicle may cause a corresponding temporary, local increase in the amount of biologically damaging ultraviolet light that reaches the ground (although, as discussed in Section 3.11, this has yet to be experimentally verified). As was noted earlier, these local holes only exist for a matter of minutes to hours. Because launches at the two ranges are always separated by at least a few days, combined impacts in the sense of these local holes combining or reinforcing one another cannot occur. Thus, the peak annual combined EELV program emissions of the Proposed Action into the stratosphere (given individually for Vandenberg AFB and CCAFS in Table 4.11-9) are presented to quantify the maximum annual potential for this kind of local impact. As noted in Table 4.11-9, the year in which the most pollutants

TABLE 4.11-9
Peak Annual Combined EELV Launch Emissions into the Upper Atmosphere with Proposed Action (in tons)

	Particulate[a]	NO_x[b]	Cl_x[c]
Vandenberg AFB (all values for year 2008)			
Free Troposphere	200	6.0	100
Stratosphere	130	0.14	64
CCAFS			
Free Troposphere	700[d]	14[e]	350[d]
Stratosphere	440[d]	0.42[e]	220[d]
CCAFS + Vandenberg AFB (all values for year 2008)			
Free Troposphere	870	18	440
Stratosphere	550	0.54	270

[a]Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b]NO_x represents the total of NO and a small amount of NO_2.
[c]Cl_x represents the total of HCl, Cl_2, Cl, and ClO.
[d]Peak annual emissions in year 2004.
[e]Peak annual emissions in year 2015.

would be emitted locally into both the free troposphere and the stratosphere at Vandenberg AFB from launches under the Proposed Action is expected to be 2008.

Similarly, the year in which the most pollutants would be emitted locally into both the free troposphere and the stratosphere at CCAFS from launches under the Proposed Action is expected to be 2004 for particulates and Cl_x, and 2015 for NO_x.

4.11.4 Cumulative Impacts

Cumulative, global impacts to the stratosphere from EELV launch activities have also been considered. Jackman, et al. (1998) estimated that the steady-state annual-averaged total global ozone percent change of –0.033 percent assuming nine shuttle missions and three Titan IV missions (Scenario D) deposited 1,941 tons of chlorine and Al_2O_3 per year into the stratosphere, over many years. The maximum total ozone decrease was found to be about 0.12 percent at the polar latitudes during the spring. Jackman also noted that the effect on ozone was approximately linear with the combined chlorine and Al_2O_3 emissions. Using these values, the total annual chlorine and Al_2O_3 loading would be 1,941 tons per year, which results in an annual global ozone depletion of 1.7×10^{-5} percent per ton released and a peak depletion of 6.18×10^{-2} percent per ton. Assuming that the Proposed Action would deposit 820 tons (see Table 4.11-9, CCAFS plus Vandenberg AFB emissions) of chlorine and Al_2O_3 in the stratosphere every year, the estimated global average ozone reduction would be approximately 0.014 percent per year. By comparison, a 3 to 7 percent annual decrease in ozone at mid-latitudes occurs as a result of the current accumulation of ODS in the stratosphere. Although this amount of depletion from the Proposed Action would be additive to the ozone depletion from global release of CFC and other ODS, this contribution (which is based on the maximum expected number of launches with SRMs) would not result in appreciable cumulative effects; the decrease in global ozone

attributable to the Proposed Action is less than 0.1 percent of existing conditions. The worldwide contribution of chlorine containing compounds from lift vehicles using SRMs would depend on the launch rates of U.S. and foreign vehicles listed in Section 2.4.1.2.

In terms of global effects, as noted in Section 3.11, rocket exhaust products have stratospheric residence times on the order of a few years. During this time, the pollutants are distributed globally, so the peak annual cumulative EELV emissions into the stratosphere given in Table 4.11-9 for the combined launches at Vandenberg AFB and CCAFS are presented to quantify the maximum annual potential for this kind of global impact. As noted in Table 4.11-9, the greatest total amount of pollutants is expected to be emitted into both the free troposphere and the stratosphere under the Proposed Action in 2008, resulting in an insignificant impact.

4.11.5 No-Action Alternative

In the 1998 FEIS it was assumed for estimation purposes that all CCAFS launches will be GTO missions and that all Vandenberg AFB launches would be LEO missions. The Atlas V lift vehicles use a common core booster that burns RP-1 and LO_2, which results in emissions of mainly CO_2 and H_2O, with small quantities of NO_X and CO. No SRM strap-ons are used with the No-Action Atlas V variants. Because the quantity of NO_x emitted is small, and the other compounds do not affect stratospheric ozone depletion, the impact of the No-Action Atlas V to stratospheric ozone would be negligible. The No-Action Delta IV lift vehicles use an LH_2/ LO_2 core booster. The Delta IV M+ variant considered in the 1998 FEIS uses up to four SRMs (GEM-46). As a result, this variant emits alumina particulate, NO_x, and chlorine substances into the upper atmosphere. However, these motors are approximately 40 percent smaller than those used in the Proposed Action. The quantities of aluminum oxide and chlorine released from the No-Action Delta IV M+ vehicle are compared to emissions from the Proposed Action and other vehicles in Tables 4.11-3 and 4.11-7. The local ozone depletion from the No-Action Delta IV M+ is compared to the Proposed Action vehicles in Tables 4.11-4 and 4.11-8. Under the No-Action Alternative, the Delta IV M and Delta IV H variants would have negligible NO_x emissions and therefore, negligible effect on stratospheric ozone. These emission estimates are provided in Table 4.11-6 and in the 1998 FEIS.

Table 4.11-10 summarizes the peak annual upper atmospheric emissions from the No-Action Alternative. Because there are fewer launches and smaller SRMs in the No-Action Alternative, the total amount of chlorine and Al_2O_3 deposition to the stratosphere will be less than for the Proposed Action. Furthermore, only the Boeing Delta IV M+ vehicle would use SRMs.

Using the methodology described in Section 4.11.3, the No-Action Alternative has been calculated to deposit a total of 24 tons of chlorine and Al_2O_3 per year into the stratosphere, which will result in an annual global ozone reduction of 0.0004 percent, an insignificant impact. The cumulative impacts under the Proposed Action alternative (see Section 4.11.4) will be greater than the cumulative impacts from the No-Action Alternative.

TABLE 4.11-10
No-Action Peak Annual Launch Emissions into the Upper Atmosphere (tons per year)

	Particulate[a]	NO_x[b]	Cl_x[c]
Vandenberg AFB (all values for year 2008)			
Free Troposphere	56	6.5	28
Stratosphere	5.3	0.050	2.6
CCAFS			
Free Troposphere	110[d]	14[e]	56[d]
Stratosphere	11[d]	0.10[e]	5.3[d]
CCAFS + Vandenberg AFB (all values for year 2008)			
Free Troposphere	170	17	84
Stratosphere	16	0.14	8.0

[a] Particulate represents the total of Al_2O_3 + $AlO_xH_yCl_z$.
[b] NO_x represents the total of NO and a small amount of NO_2.
[c] Cl_x represents the total of HCl, Cl_2, Cl, and ClO.
[d] Peak annual emissions in year 2004.
[e] Peak annual emissions in year 2015.

4.12 Noise

This section describes noise impacts from the Proposed Action and No-Action Alternative. Because both the Proposed Action and the No-Action Alternatives involve lift vehicles that have not yet been built and launched, noise measurements are not available. Launch and ascent noise were computed by the RNOISE model recently developed for lift vehicle analysis (Plotkin, et al.; 1997). Sonic booms were computed using the U.S. Air Force PCBoom3 model (Plotkin, 1996). Appendix U contains descriptions of these models, plus background information on noise. Appendix O provides background information regarding the underwater noise analysis.

4.12.1 Proposed Action

This describes noise and sonic boom impacts associated with the Proposed Action, which includes both the Atlas V and Delta IV systems.

4.12.1.1 Atlas V System

This section describes the difference in noise and sonic boom impacts associated with adding SRMs to the Atlas V system. The Proposed Action for this system would include configurations with up to five SRMs added to a single liquid engine core stage. Each solid rocket has a nominal thrust of 280,000 pounds. With the core stage thrust of 850,000 pounds, the total nominal thrust with the maximum of five SRMs would be 2.25 million pounds. This amount represents a larger vehicle than the Atlas V-300/400 vehicle (one liquid core, 850,000 pounds), but is smaller than the Atlas V-Heavy (one liquid core plus two liquid boosters, 2.55 million pounds).

Noise analysis was performed for four launches of an SRM-augmented Atlas V vehicle. For the purposes of this FSEIS, the vehicle with the greatest potential for noise impacts was evaluated—an Atlas V vehicle using five SRMs (Atlas V 551/552). Of the four launches that were modeled, two launches were from CCAFS and two launches were from Vandenberg

AFB. Noise and sonic boom footprints for all four launches were similar to one another, with differences at each location associated primarily with launch azimuth. In the following analysis, results are shown for one mission at each site, and the potential differences between the missions was analyzed and other potential launches are discussed.

The launch rates expected at each site would be on the order of one every other month, considerably less than the one-per-day rate at which cumulative noise metrics such as the day-night average noise level (Ld_n) are meaningful. Analysis of impacts, therefore, concentrates on single-launch events.

4.12.1.1.1 Cape Canaveral Air Force Station

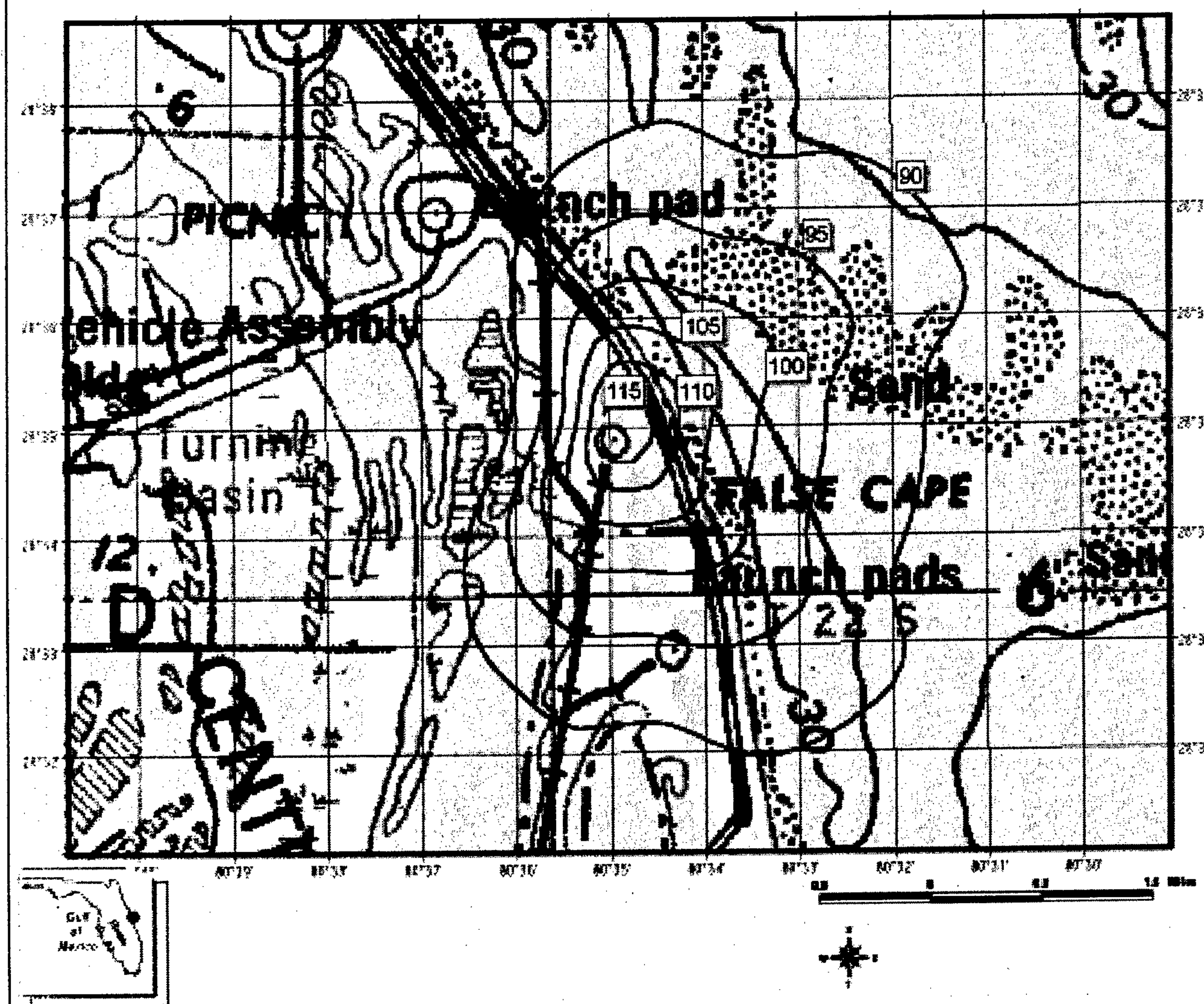
On-Pad Rocket Noise. Figure 4.12-1 shows the maximum on-pad A-weighted sound levels for launch of an Atlas V 551/552. Figure 4.12-2 shows the maximum overall sound levels. The levels shown in Figures 4.12-1 and 4.12-2 would occur when all engines are firing, and the vehicle is on the launch pad or close enough to it that the rocket exhaust enters the deflector and exhaust tunnel. The highly directional pattern would be a result of the deflector and tunnel. Noise levels would be highest toward the east, over the ocean. Noise levels inland would be comparable to or lower than those associated with in-flight levels, presented below.

On-pad noise contours for all vehicles of this configuration would be similar to those shown here, since the direction is set by the launch pad configuration. The noise levels from the Atlas V 551/552 vehicle generally would be two to three decibels (dB) lower than those from the heavy-lift variants.

In-Flight Rocket Noise. Figure 4.12-3 shows the A-weighted sound levels for in-flight noise from an Atlas V 551/552 LEO mission at a launch azimuth of 38 degrees, which represents the maximum level that would occur during the course of a launch after the vehicle is clear of the pad. The contours would be approximately circular, with a bulge at lower levels in the direction of the launch. This bulge, which would always be over the ocean, would change with different azimuths, but would involve noise levels too low to affect the impact analysis.

The A-weighted levels at the nearest communities, 8 to 10 miles away, would be in the 70 to 73 dB range, somewhat louder than the noise of a passing automobile (65 to 70 dBA) and much less than that of a passing heavy trucks (80 to 85 dBA). Occasional sounds of this level would not cause adverse impacts. The sound-exposure level (SEL) computed for this launch is about 13 dB higher than the A-weighted sound pressure level (AWSPL). The major portion of the sound energy in the event would occur over a duration of about 20 seconds. Launch noise would likely be audible for a slightly longer period, but the total time involved would not be great enough to cause significant impacts.

Figure 4.12-4 shows the overall sound pressure level for this launch. The higher-level contours would be approximately circular, so these contours would not be affected by launch azimuth. Overall sound-pressure level (OSPL) in excess of 110 dB, which could cause structural damage claims at a rate of 1 per 1,000 households, would be limited to a radius of approximately 2.8 miles from the launch site. This area does not contain residential communities, and most of the land area affected would be within CCAFS and Kennedy Space Center (KSC) boundaries. The overall level at the nearest residential communities,

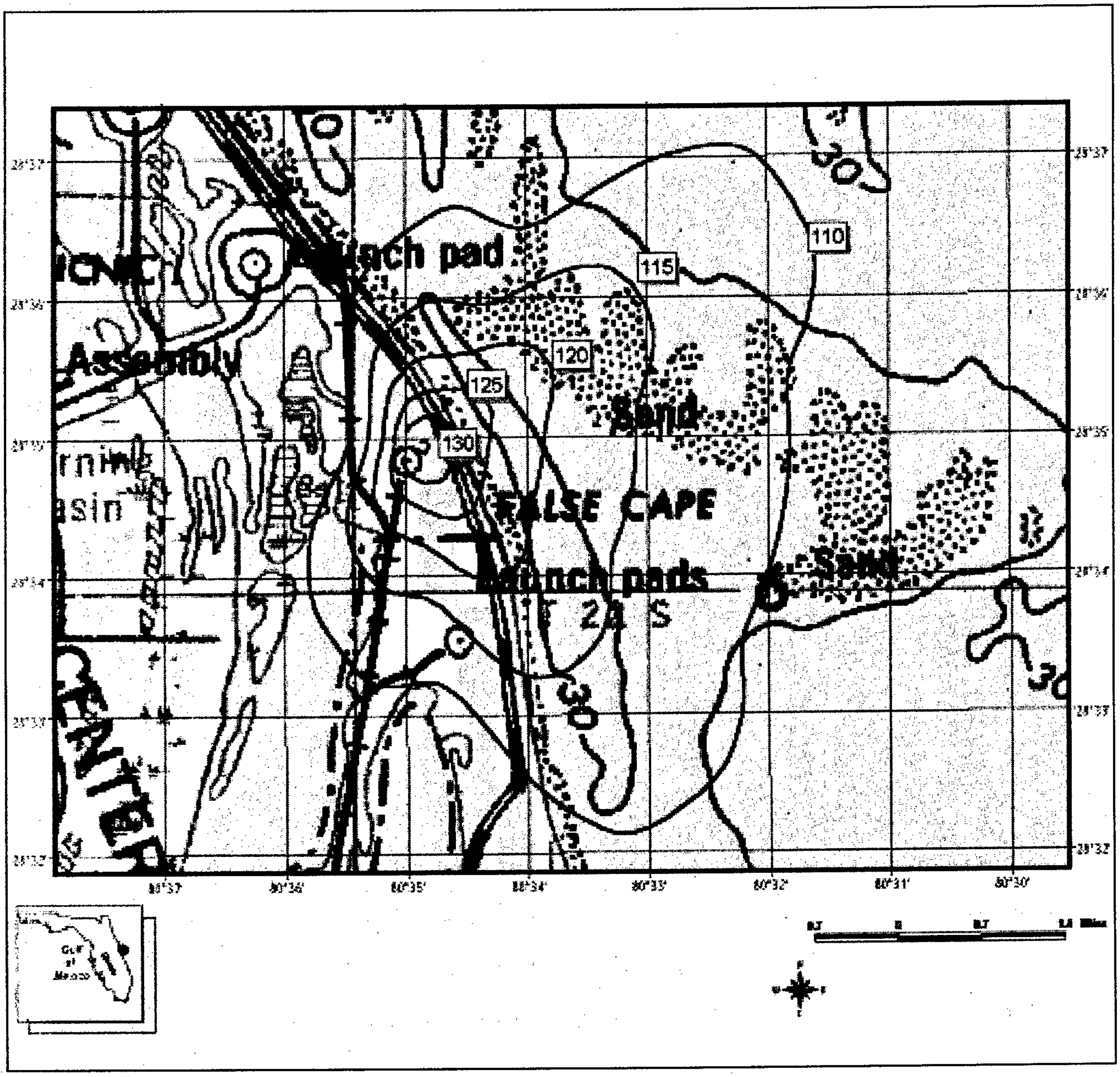


EXPLANATION

$\boxed{115}$ = 5 dBA contour intervals

On-Pad A-Weighted Sound Pressure Level Atlas V 551/552 CCAFS, Florida

Figure 4.12-1

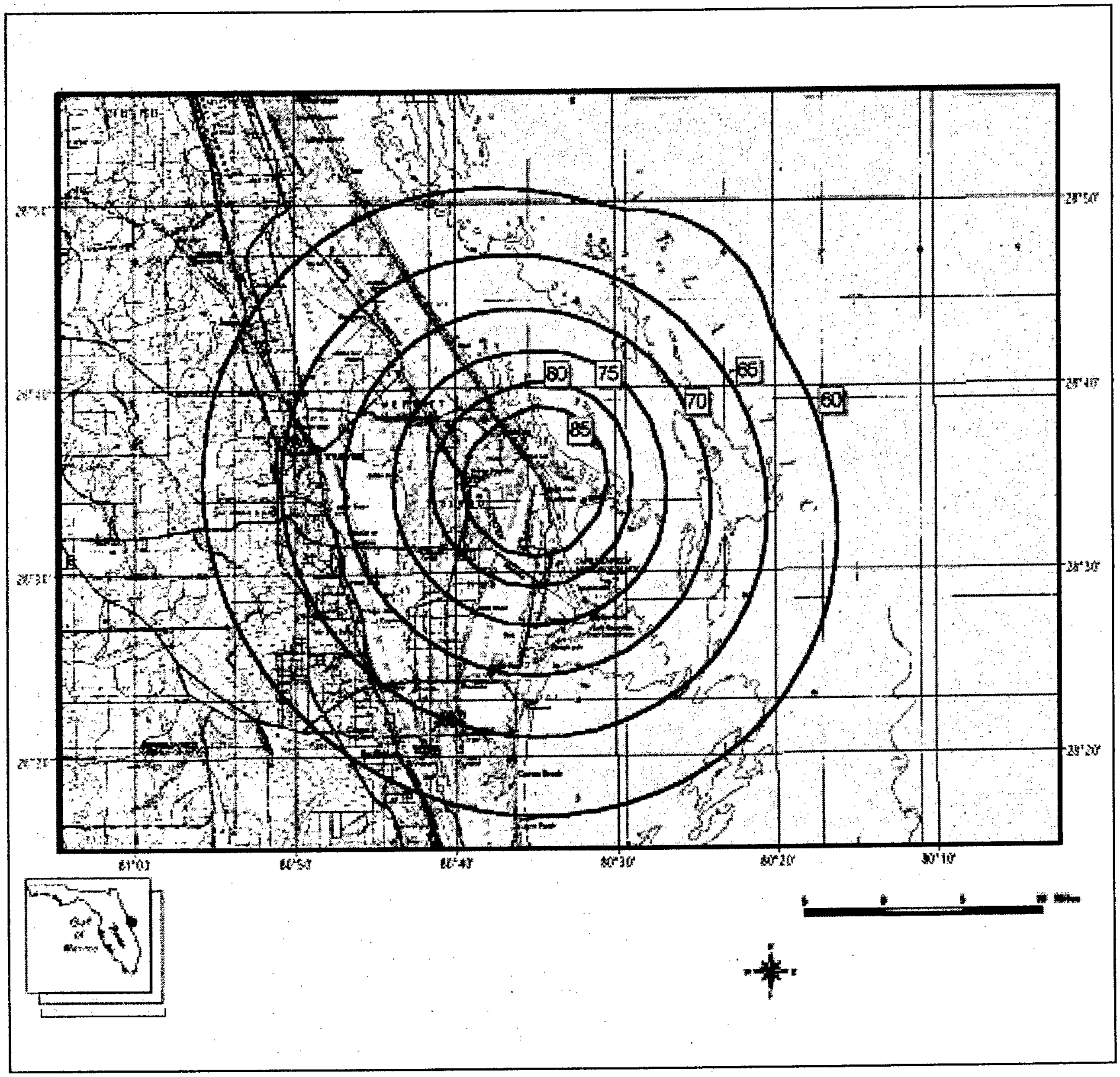


EXPLANATION

$\boxed{130}$ = 5 dB Contour Intervals

On-Pad Overall Sound Pressure Level Atlas V 551/552 CCAFS, Florida

Figure 4.12-2

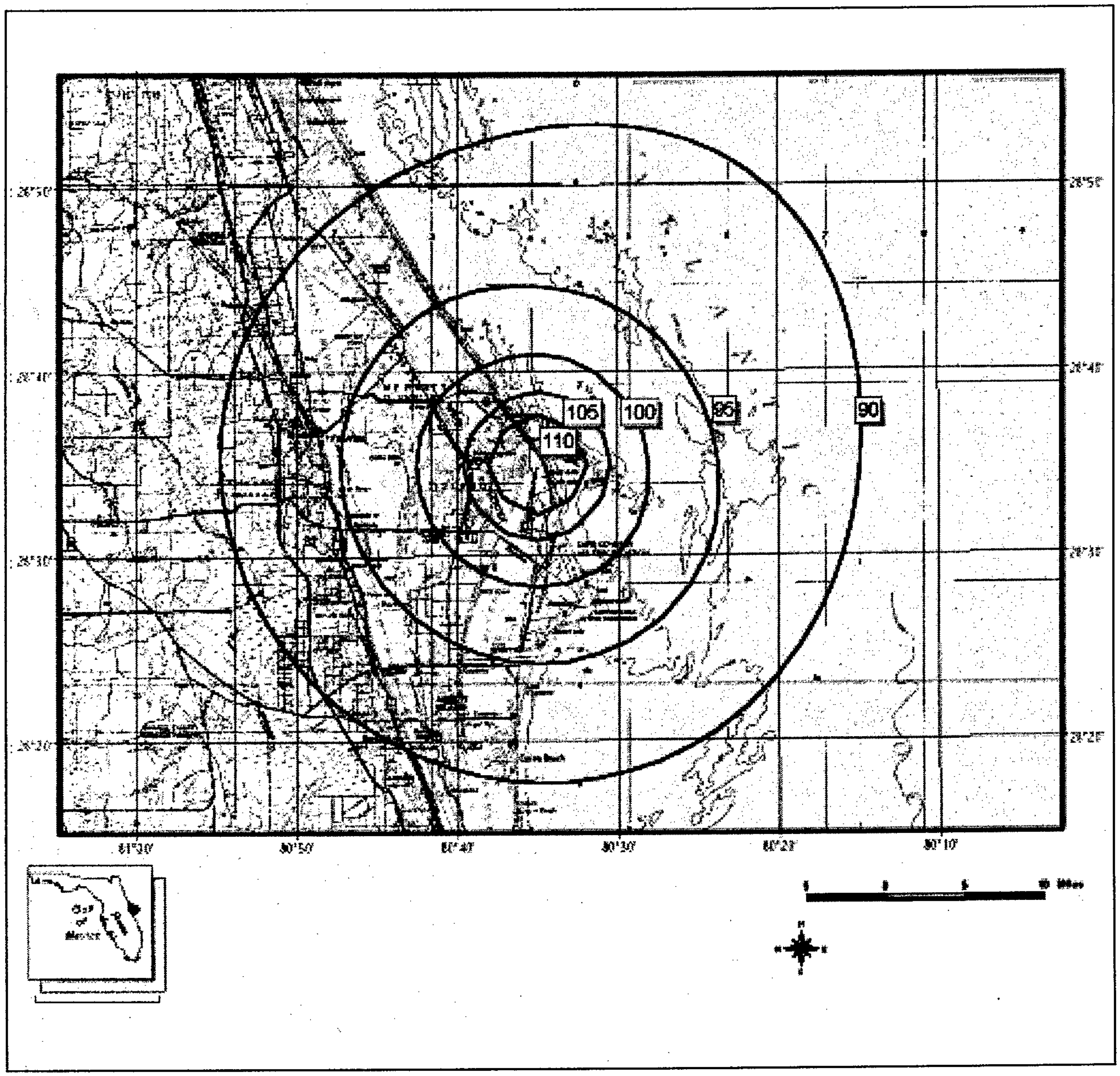


EXPLANATION

85 = 5-dBA Contour Intervals

In-Flight A-Weighted Sound Pressure Level Atlas V 551/552 (LEO) CCAFS, Florida

Figure 4.12-3



EXPLANATION

$\boxed{110}$ = 5-dB Contour Intervals

In-Flight Overall Sound Pressure Level Atlas V 551/552 (LEO) CCAFS, Florida

Figure 4.12-4

8 to 10 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

Both the A-weighted and overall sound pressure levels for this launch would be 2 to 3 dB lower than the corresponding levels from the heavy-lift variants.

Sonic Boom. Figure 4.12-5 shows the sonic boom footprint for this launch. The maximum overpressure would be 7.2 psf, and would cover an area too small to be seen in the figure. The lowest contour value drawn is 0.5 psf. This footprint is aligned with the launch azimuth, and would occur over the Atlantic Ocean, well offshore. Atlas V launch azimuths would fall within the 37 to 114 degree range shown in Figure 3.12-3 of the 1998 FEIS, so that sonic boom footprints would always be entirely over the Atlantic Ocean. The potential impacts of these footprints on wildlife are discussed in Section 4.14. The sonic boom footprint for this vehicle configuration would be similar to that for the other configurations associated with the No-Action Alternative. The largest of the HLVs would have a maximum sonic boom overpressure about 5 percent greater than that of the vehicles in the Proposed Action.

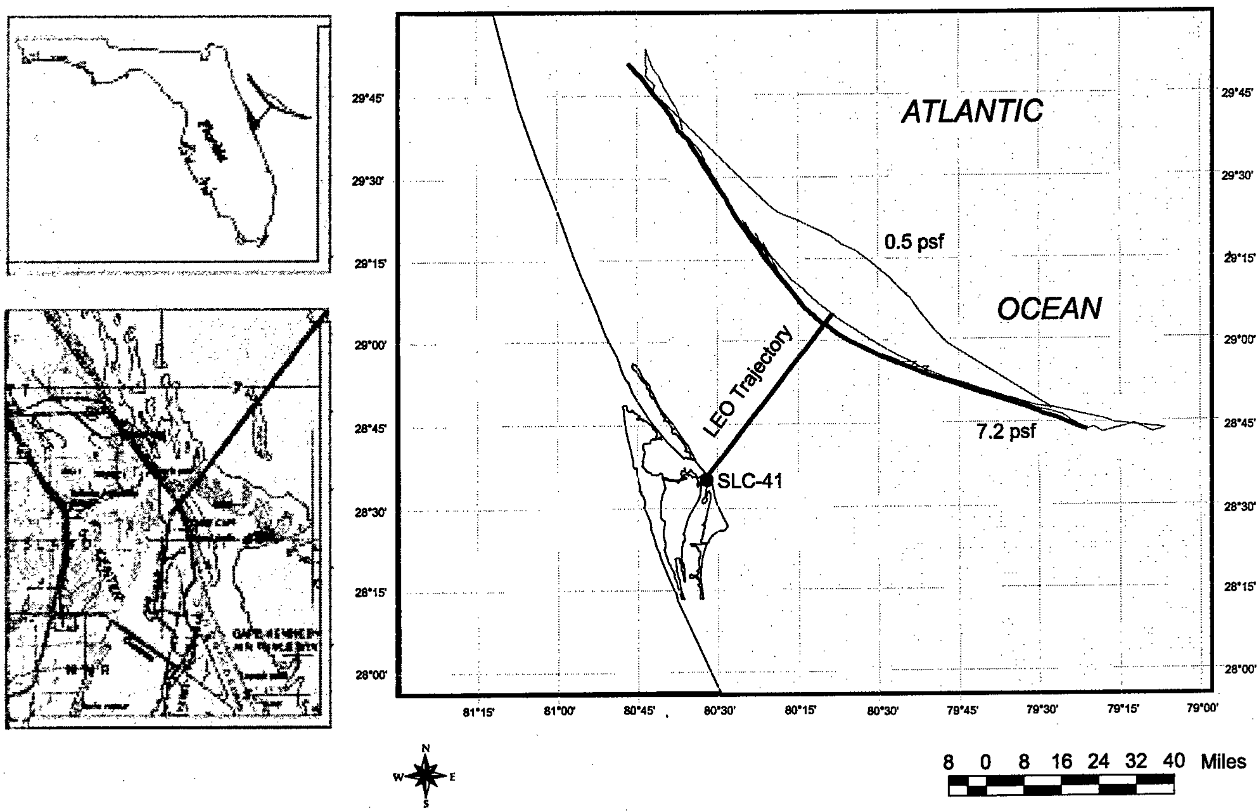
Underwater Penetration of Sonic Boom. The sea-level waveforms from the Atlas V 551/552 launches would be quite close to one another for each of the four sonic boom types: the focus boom (FOC), edge focus boom (EDG), carpet boom (CPT) and carpet boom 1/2 (CP2) (see Appendix O), with exceptions noted below.

Sonic booms occurring during launches from the ER would cause maximum sea-level overpressure waveforms of the Atlas V 551/552 (LEO launch), to be 7.3 psf in FOC, 3 psf in EDG, 2.8 psf in CPT, and 1.9 psf in EDG. The FOC and EDG waveforms appear to be the results of adding the two spikes (rabbit ears) to a slightly modified N-wave. The signature length of these waveform would vary slightly within 600 to 650 feet, except for the longer length (1,030 feet) in the CP2. The sea-level waveforms for the Atlas V 551/552 for the LEO launch would be very close to those shown for Atlas V 551/552 for the GTO launch.

A significant feature of sonic booms penetration underwater, which is shared by all launches considered by the Proposed Action, is that high overpressures compared to those on the sea surface would be found mainly within the first 60 feet below the surface, and would be the result of the focus and edge booms. Below this level, the carpet boom wave field would become more important. Overpressure magnitudes attenuate rapidly with increasing depth, reducing to 0.3 psf or less at the 400-foot depth. Similar results would occur for an Atlas V 551/552 for the LEO launches.

4.12.1.1.2 Vandenberg AFB

On-Pad Rocket Noise. Figure 4.12-6 shows the maximum on-pad A-weighted sound levels for launch of an Atlas V551/552. Figure 4.12-7 shows the maximum overall sound levels. Noise levels would be highest toward the southwest, over the Pacific Ocean. Noise levels inland would be comparable to or lower than those associated with in-flight levels, which are presented below. On-pad noise contours for all vehicles of this configuration would be similar to those shown here, because the direction is set by the launch pad configuration. The noise levels would be generally two to three dB lower than those from the heavy-lift variants.

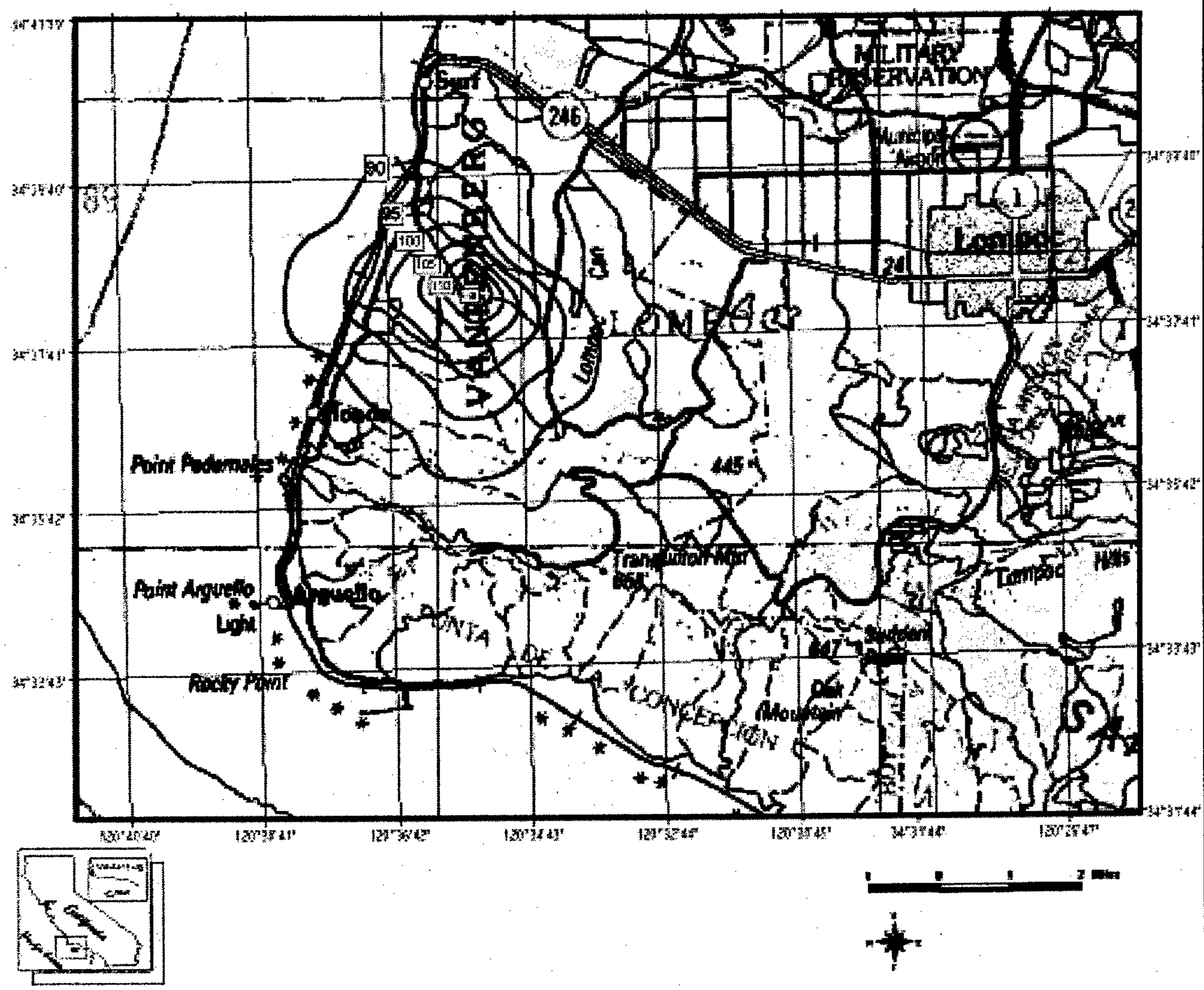


EXPLANATION

psf = pounds per square foot

Sonic Boom Footprint, Atlas V 551/552 (LEO) CCAFS, Florida

Figure 4.12-5

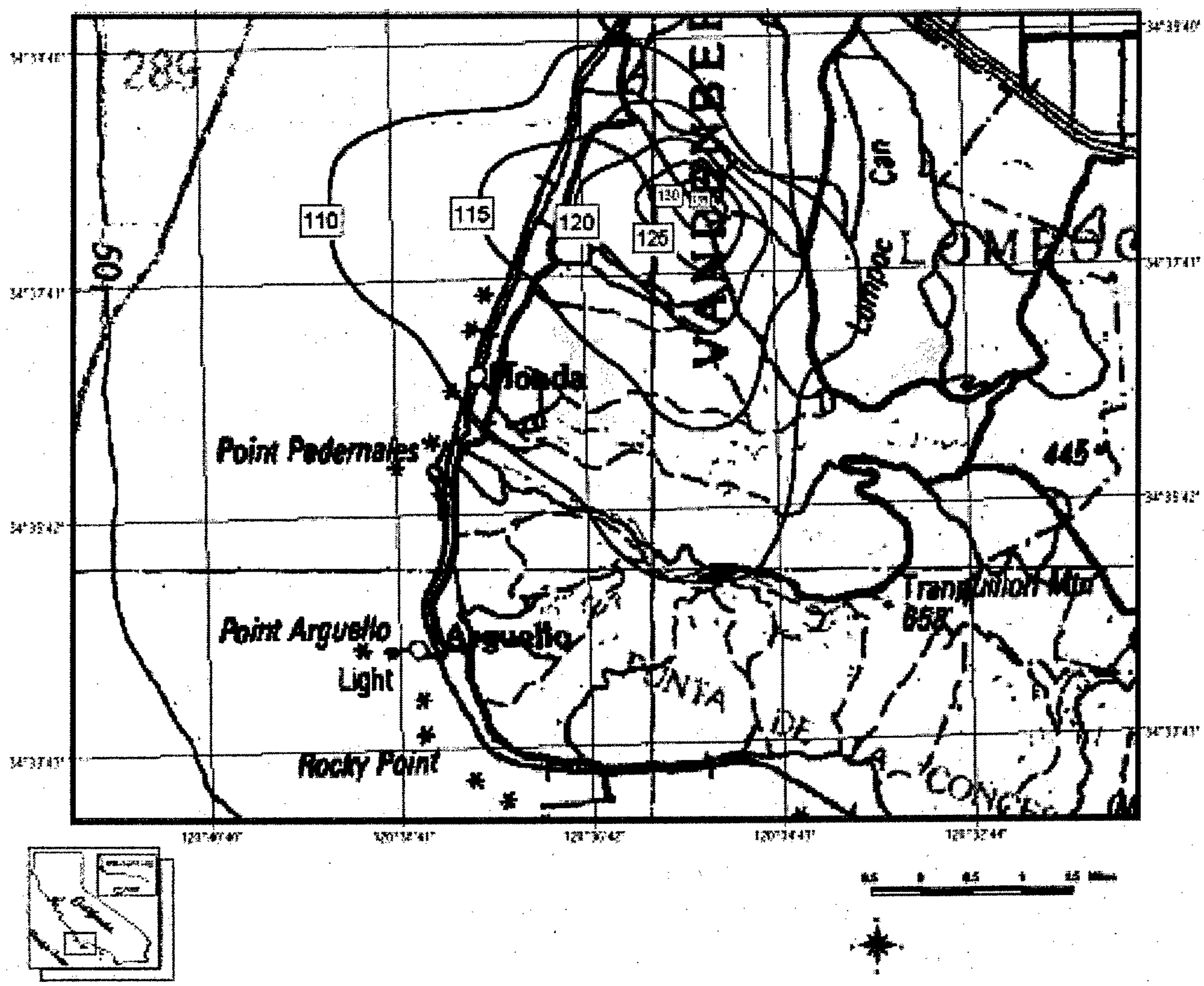


EXPLANATION

115 = 5-dBA Contour Intervals

On-Pad A-Weighted Sound Pressure Level Atlas V 551/552 Vandenberg AFB, California

Figure 4.12-6



EXPLANATION

$\boxed{135}$ = 5-dB Contour Intervals

On-Pad Overall Sound Pressure Level Atlas V 551/552 Vandenberg AFB, California

Figure 4.12-7

SCO/152209.00.03.01.03 4.12-7.fh8 10/21/99

In-Flight Rocket Noise. Figure 4.12-8 shows the A-weighted sound levels for in-flight noise from an Atlas V 551/552 LEO mission at a launch azimuth of 158 degrees, which represents the maximum level that would occur during the course of a launch during the time after the vehicle is clear of the pad. The contours are approximately circular, with a bulge at lower levels in the direction of the launch. This bulge, which is always over the ocean, would change with different azimuths but would involve noise levels that are too low to affect the impact analysis.

The A-weighted levels at the nearest communities would be in the 80 dB range, louder than the noise of a passing automobile (65 to 70 dBA) and slightly less than that of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level would not cause adverse impacts. SEL has been computed for this launch and is about 13 dB higher than the AWSPL. The event duration would last about 20 seconds. Launch noise would likely be audible for a longer period, but the total time involved would not be great enough to cause significant impacts.

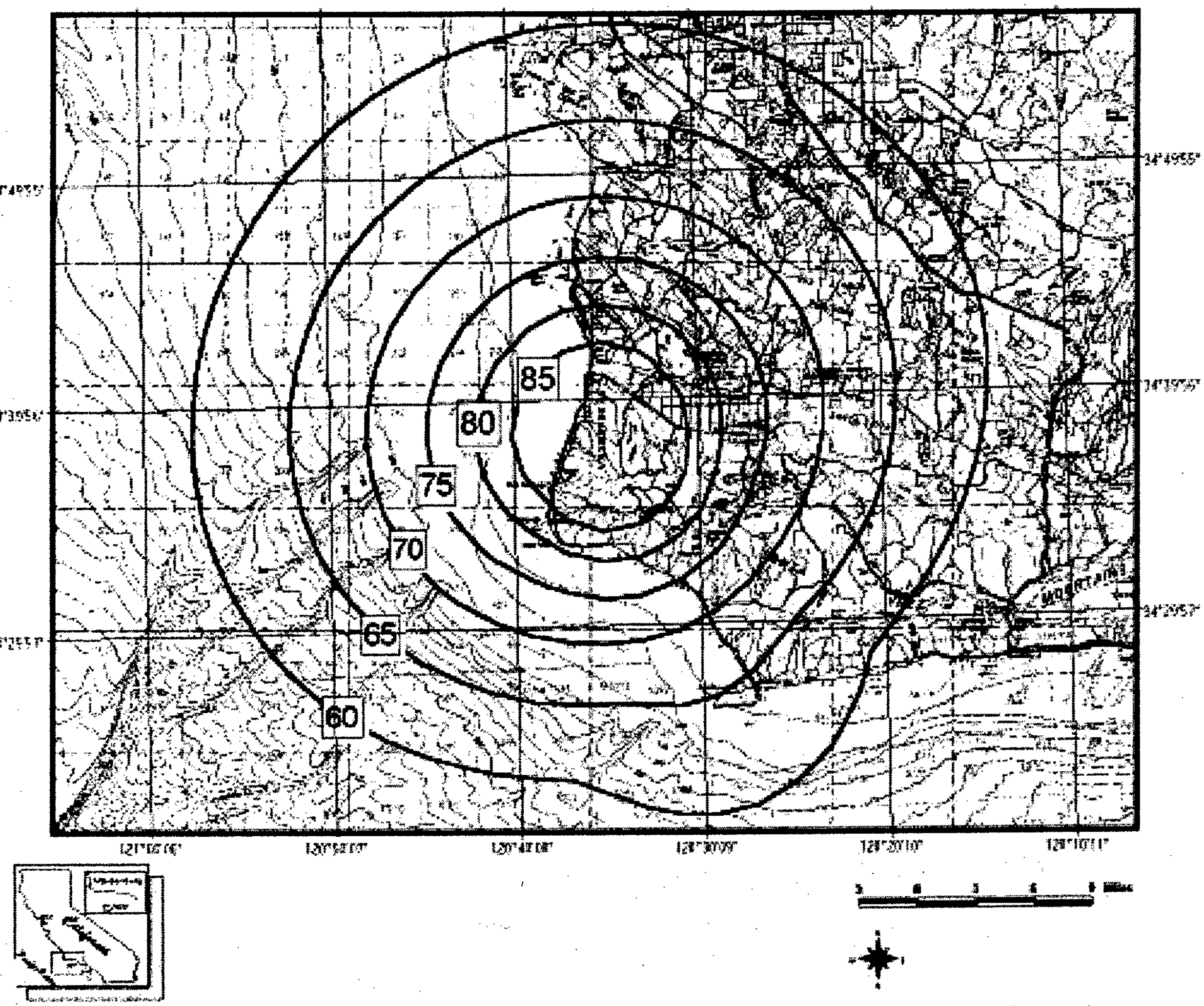
Figure 4.12-9 shows the overall sound pressure level for this launch. The higher-level contours would be approximately circular, so launch azimuth is not important. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of 1 per 1,000 households, would be limited to a radius of approximately 2.8 miles from the launch site. This area does not contain residential communities, and most of the land area affected would be within the Vandenberg AFB boundary. The overall level at the nearest residential communities would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

Both the A-weighted and overall sound pressure levels for this launch would be 2 to 3 dB lower than the corresponding levels from the heavy-lift variants.

Sonic Boom. Figure 4.12-10 shows the sonic boom footprint for this launch. The maximum overpressure would be 7.2 psf, and would cover an area too small to be seen in the figure.

The lowest contour value drawn would be 0.5 psf. This footprint would be aligned with the launch azimuth, and would fall in the Pacific Ocean, well offshore. Atlas V launch azimuths would fall within the 140 to 201 degree range shown in the 1998 FEIS, so that sonic boom footprints would usually be entirely over the Pacific Ocean. There is a potential that the edge of a boom footprint could intercept the mainland for azimuths near the eastern limit. However, sonic booms in this region would be attenuated by distance and ground effects, and would tend to sound more like distant thunder than an actual sonic boom.
Figure 4.12-10 shows that San Miguel and Santa Rosa Islands would be within the sonic boom footprint. For this particular launch, the boom would generate overpressures below 1 psf, which is a level not usually expected to cause adverse effects. However, other launch azimuths and missions could result in higher amplitude sonic booms affecting these islands. As noted in Section 3.12, such sonic booms routinely occur from current launch activities at Vandenberg AFB. Potential impacts from these activities on wildlife on the Channel Islands and in the Pacific Ocean are discussed in Section 4.14.

The sonic boom footprint for this vehicle configuration would be similar to that for the other configurations associated with the No-Action Alternative. The HLVs would have a

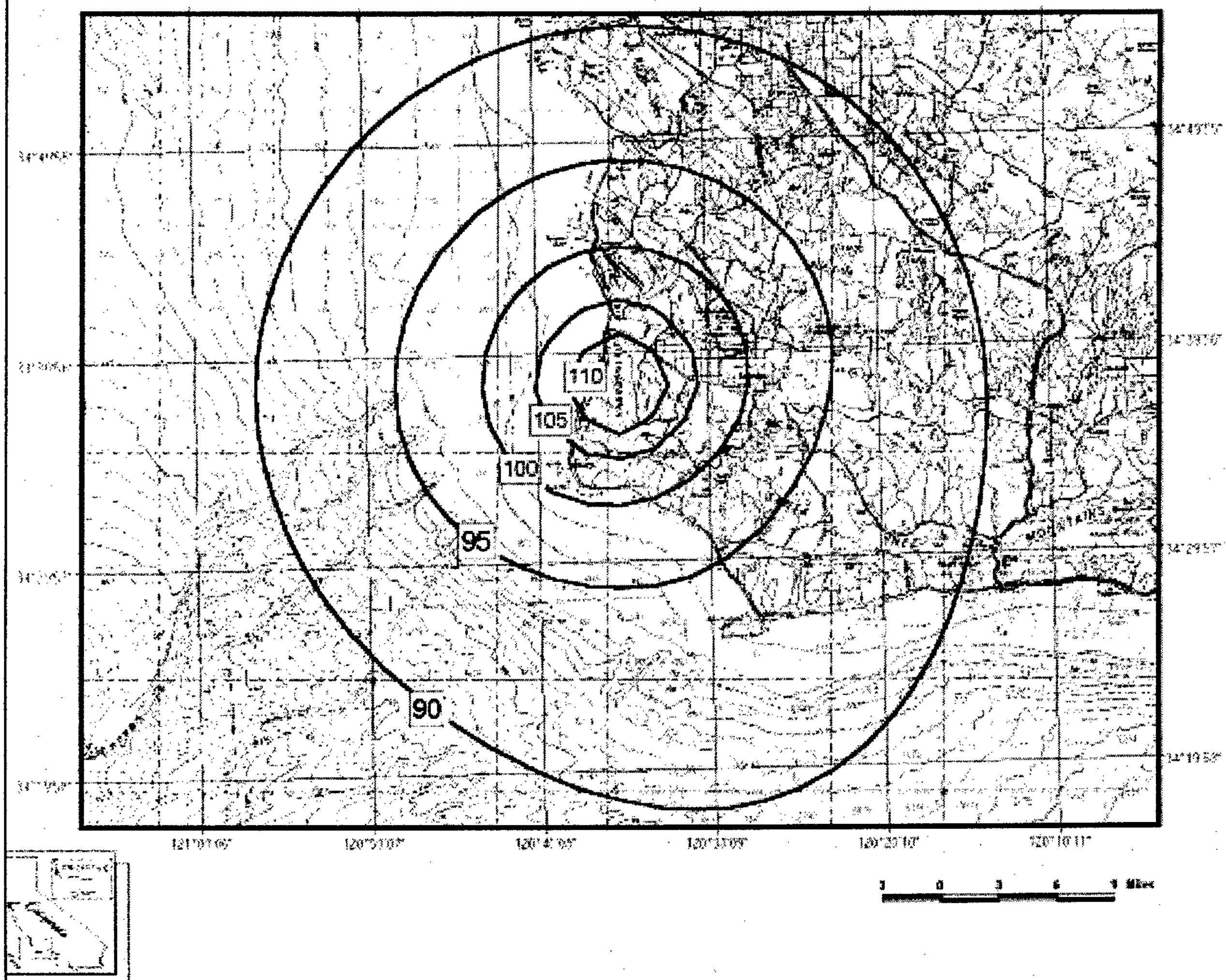


EXPLANATION

85 = 5-dBA Contour Intervals

In-Flight A-Weighted Sound Pressure Level Atlas V 551/552 (LEO) Vandenberg AFB, California

Figure 4.12-8

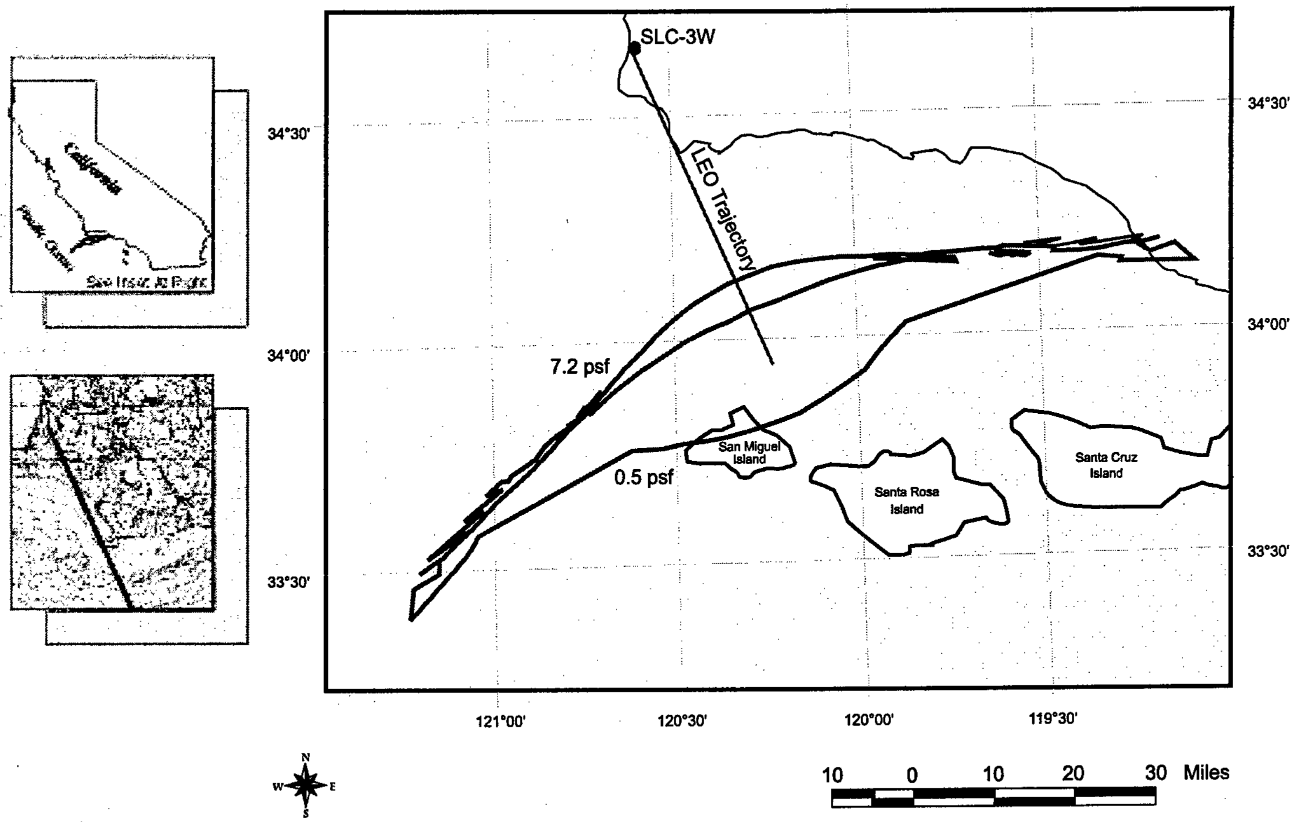


EXPLANATION

$\boxed{110}$ = 5-dB Contour Intervals

In-Flight Overall Sound Pressure Level Atlas V 551/552 (LEO) Vandenberg AFB, California

Figure 4.12-9



EXPLANATION

psf = pounds per square foot

Sonic Boom Footprint Atlas V 551/552 (LEO) Vandenberg AFB, California

Figure 4.12-10

maximum sonic boom overpressure approximately 5 percent larger than that of the vehicles in the Proposed Action.

Underwater Penetration of Sonic Boom. The launches from the Western Range yield sea-level sonic boom waveforms close to those from the Eastern Range in their respective waveform types (see Section 4.12.1.1.1 above). Similarly, the plots of maximum overpressure versus depth for range of likely west-range launches reveal little variation from launch to launch, and are similar to those of the Eastern Range launches. Additional details regarding the underwater noise modeled from these launches are presented in Appendix O.

4.12.1.2 Delta IV System

This section describes the difference in noise and sonic boom impacts associated with adding larger SRMs to the Delta IV system. The Proposed Action for this system would include configurations that have up to four solid rocket boosters added to a single liquid engine core stage. Each solid rocket has a nominal thrust of 280,000 pounds. With the core stage thrust of 650,000 pounds, nominal thrust is 1.75 million pounds, which represents a larger vehicle than the Delta IV M (one liquid core, 650,000 pounds), but is smaller than the Delta IV H vehicle (one liquid core plus two liquid boosters, 1.95 million pounds).

Noise analysis was performed for four launches of a Delta IV vehicle with the larger SRMs. For the purposes of this FSEIS, the bounding case was evaluated — a Delta IV vehicle using four SRMs [Delta IV-M+(5,4)]. Of the four launches that were modeled, two launches were from CCAFS and two launches were from Vandenberg AFB. Noise and sonic boom footprints for all four launches were similar to one another, with differences at each location associated primarily with launch azimuth. In the following analysis, results are shown for one mission at each site, and the potential differences between the missions have been analyzed and other potential launches are discussed.

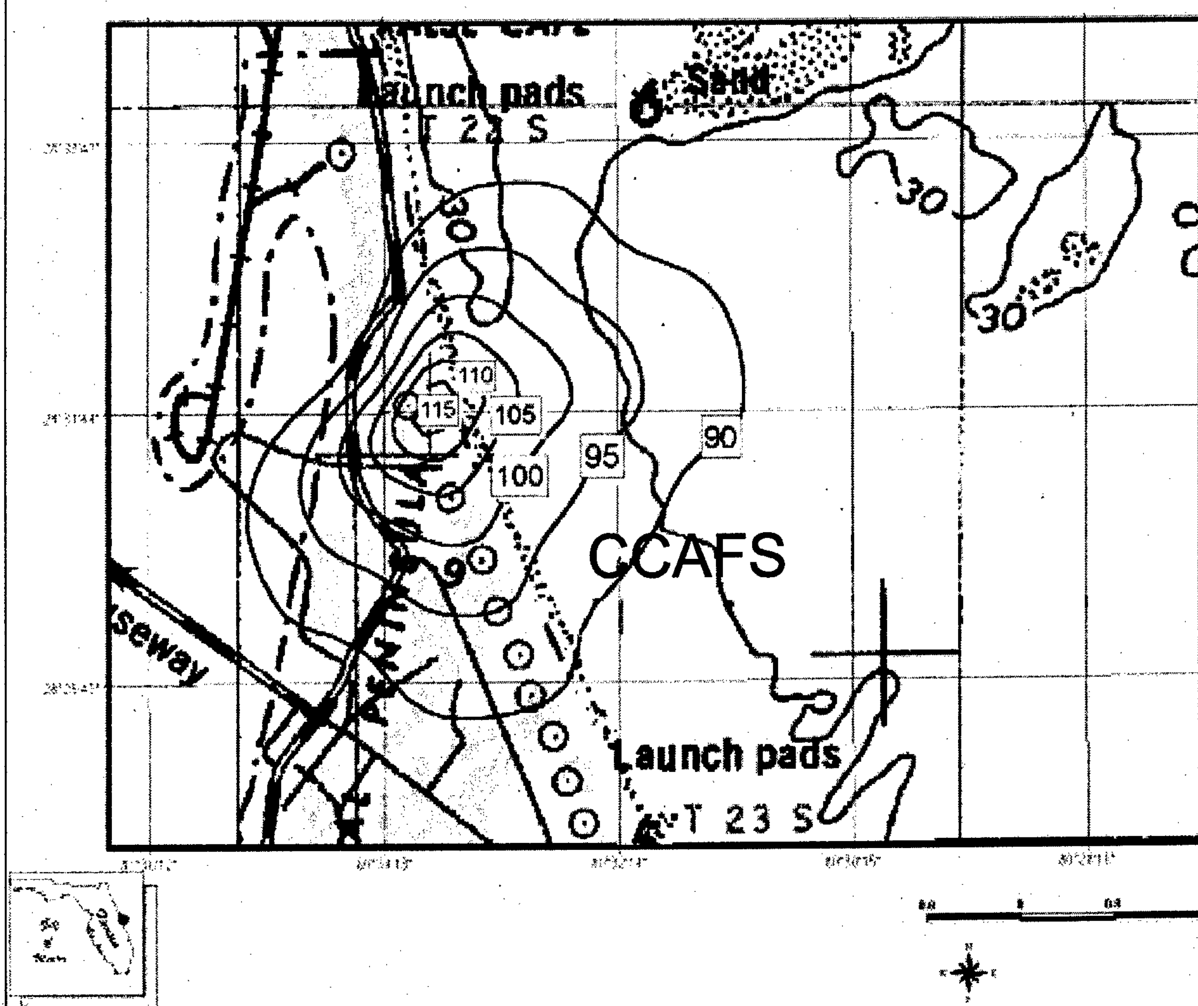
The launch rates at each site are considerably less than one per day, the rate at which cumulative noise metrics such as Ld_n would be meaningful; therefore, analysis of impacts concentrates on single launch events.

4.12.1.2.1 Cape Canaveral Air Force Station

On-Pad Rocket Noise. Figure 4.12-11 shows the maximum on-pad A-weighted sound levels for launch of a Delta IV-M+(5,4). Figure 4.12-12 shows the maximum overall sound levels. The levels shown in Figures 4.12-11 and 4.12-12 occur when all engines are firing, and the vehicle is on the launch pad, or close enough to it that the rocket exhaust enters the deflector and exhaust tunnel. The highly directional pattern would be the result of the deflector and tunnel. Noise levels would be highest toward the southeast, over the ocean. Noise levels inland would be comparable to or lower than those associated with in-flight levels presented below.

On-pad noise contours for all vehicles of this configuration would be similar to those shown here, because the direction would be set by the launch pad configuration. The noise levels would be generally two to three dB lower than those from an HLV configuration.

In-Flight Rocket Noise. Figure 4.12-13 shows the A-weighted sound levels for in-flight noise from a Delta IV-M+(5,4) for a LEO mission at a launch azimuth of 92 degrees, which represents the maximum level that would occur during the course of a launch during the

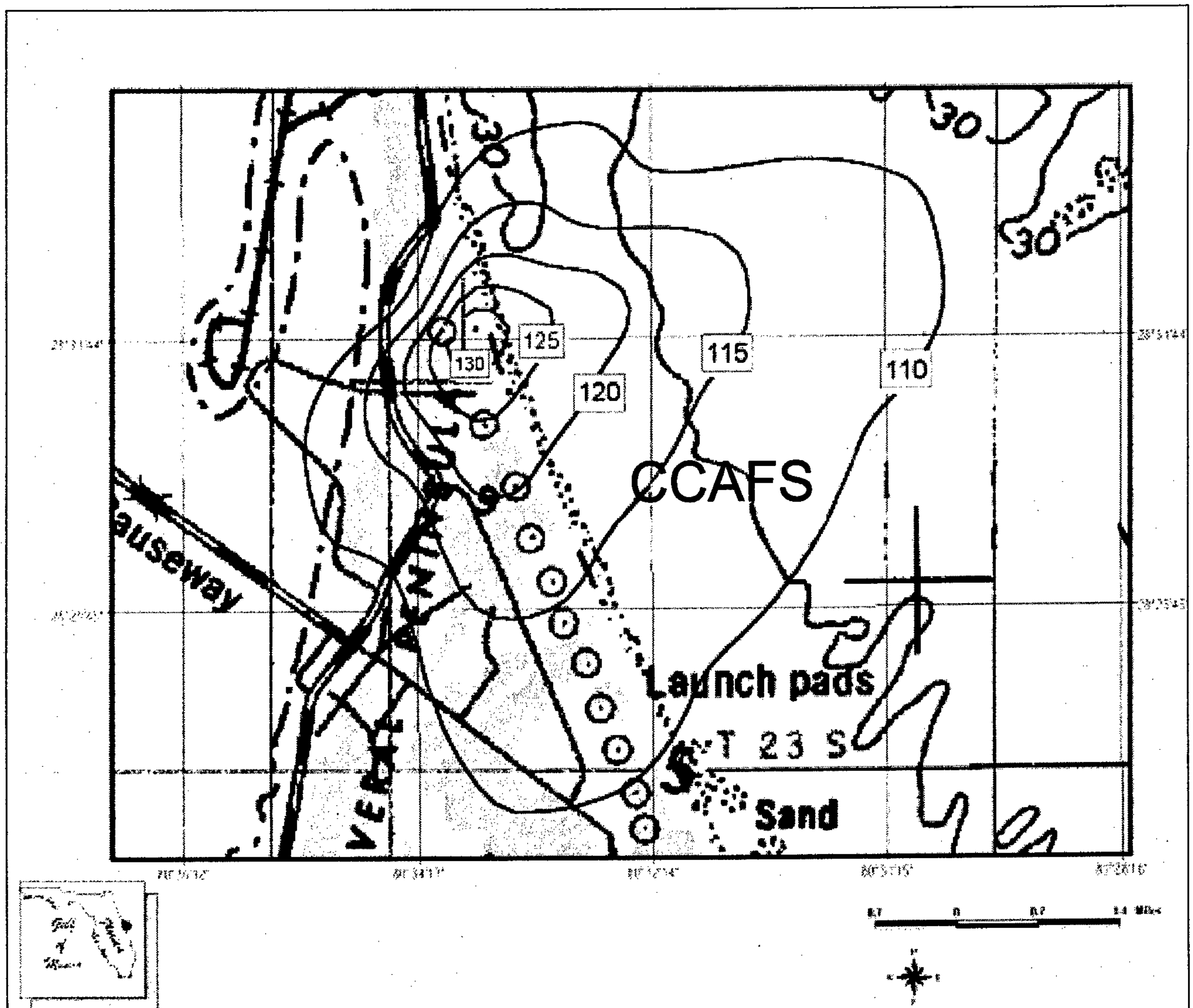


EXPLANATION

$\boxed{110}$ = 5-dBA Contour Intervals

On-Pad A-Weighted Sound Pressure Level Delta IV M+ (5, 4) CCAFS, Florida

Figure 4.12-11

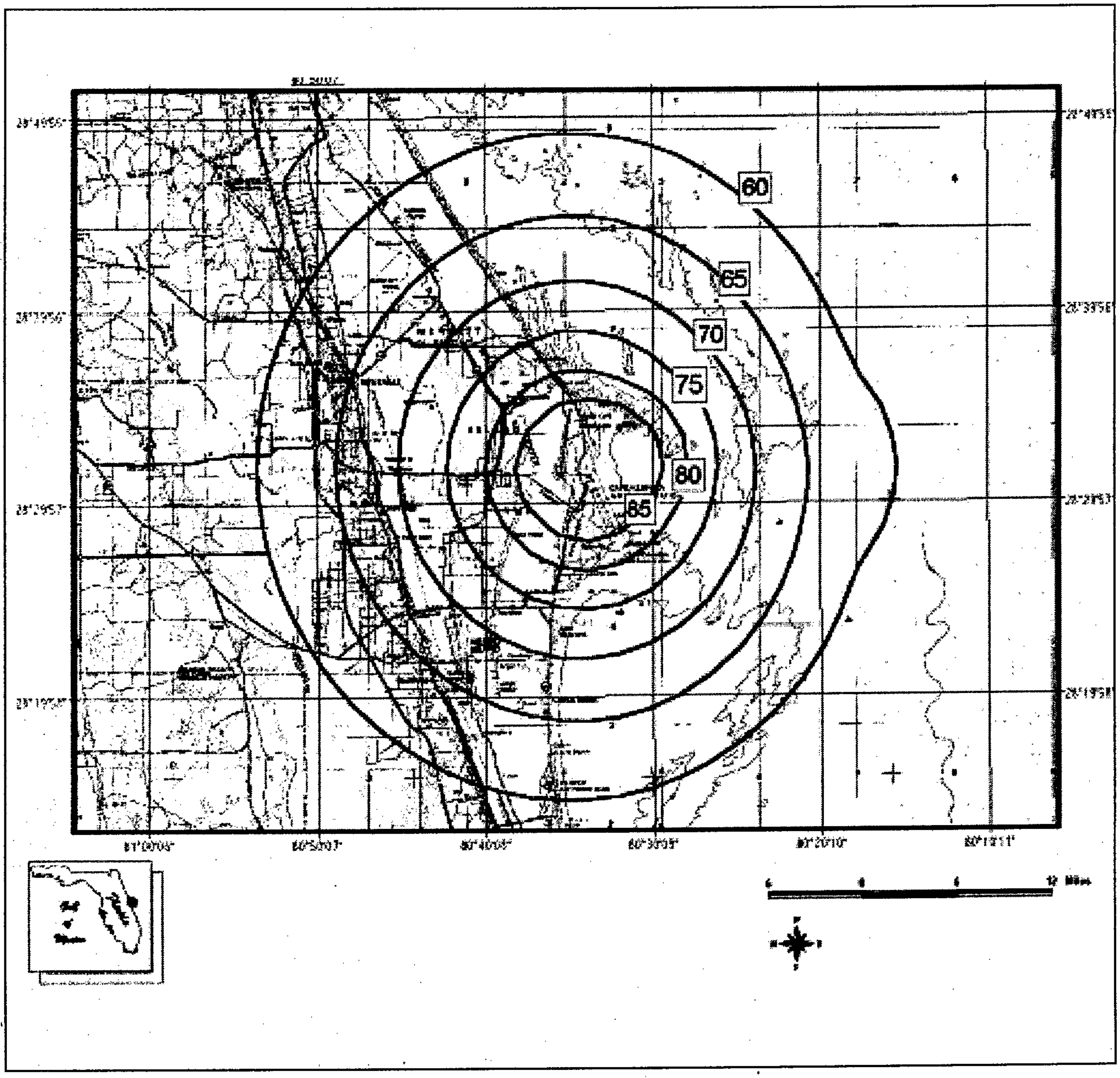


EXPLANATION

$\boxed{130}$ = 5-dB Contour Intervals

On-Pad Overall Sound Pressure Level Delta IV M+ (5, 4) CCAFS, Florida

Figure 4.12-12



EXPLANATION

$\boxed{85}$ = 5-dBA Contour Intervals

In-Flight A-Weighted Sound Pressure Level Delta IV M+ (5, 4) (LEO) CCAFS, Florida

Figure 4.12-13

time after the vehicle is clear of the pad. The contours would be approximately circular, with a bulge at lower levels in the direction of the launch. This bulge, which would always be over the ocean, would change with different azimuths, but would involve lower levels that are not important for impact analysis.

The A-weighted levels at the nearest communities, 8 to 10 miles away, would be in the 69 to 72 dB range, barely louder than the noise of a passing automobile (65 to 70 dBA) and much less than that of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level would not cause adverse impact. SEL has been computed for this launch and would be about 13 dB higher than the A-weighted sound pressure level (AWSPL). The event duration would last approximately 20 seconds. Launch noise would likely be audible for a longer period, but the total time involved would not be great enough to cause significant impacts. Figure 4.12-14 shows the overall sound pressure level for this launch. The higher-level contours would be approximately circular, so launch azimuth would not be important. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, would be limited to a radius of approximately 2.8 miles from the launch site. This area does not contain residential communities, and most of the land area affected would be within CCAFS and KSC boundaries. The overall level at the nearest residential communities, 8 to 10 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

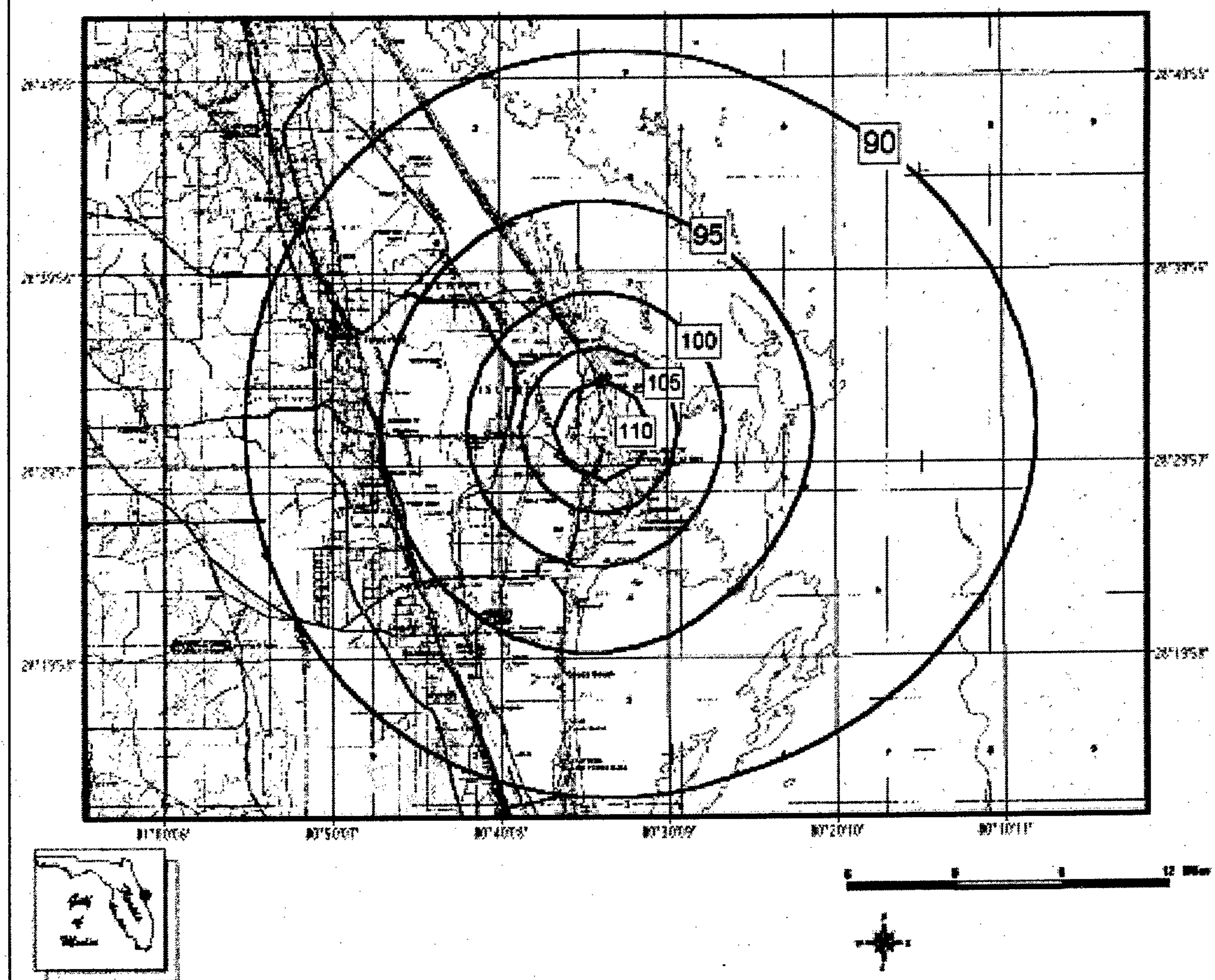
Both the A-weighted and overall sound pressure levels for this launch would be 2 to 3 dB lower than the corresponding levels from the HLVs.

Sonic Boom. Figure 4.12-15 shows the sonic boom footprint for this launch. The maximum overpressure would be 7.2 psf, and would cover an area too small to be seen in the figure. The lowest contour value drawn is 0.5 psf. This footprint would be aligned with the launch azimuth and would fall in the Atlantic Ocean, well offshore. The Delta IV launch azimuths would fall within the 37 to 114 degree range shown in the 1998 FEIS, so that sonic boom footprints would always be entirely over the Atlantic Ocean. Potential impacts on wildlife are discussed in Section 4.14. The sonic boom footprint for this vehicle configuration would be similar to that for the other configurations associated with the No-Action Alternative. The HLVs will have a maximum sonic boom overpressure approximately 5 percent larger than that of the vehicles in the Proposed Action.

Underwater Penetration of Sonic Boom. The sea level waveforms from the Delta IV-M+(5,4) would be similar for each type of sonic boom and launch, except for those from the LEO launch, which would yield lower maximum overpressure but would be similar, otherwise. In most cases, the maximum overpressure would reach approximately 7.4 psf next to the surface with the focus boom. The sea-level penetration depths for overpressure greater than 0.3 psf would range from 485 to 500 feet among various waveform and launch types. Appendix O contains additional details regarding this analysis.

4.12.1.2.2 Vandenberg AFB

On-Pad Rocket Noise. Figure 4.12-16 shows the maximum on-pad A-weighted sound levels for launch of a Delta IV M+(5,4). Figure 4.12-17 shows the maximum overall sound levels. Noise levels would be the highest toward the southwest, over the ocean. Noise levels inland would be comparable to or lower than those associated with in-flight levels presented below.



EXPLANATION

$\boxed{110}$ = 5-dB Contour Intervals

In-Flight Overall Sound Pressure Level Delta IV M+ (5, 4) (LEO) CCAFS, Florida

Figure 4.12-14

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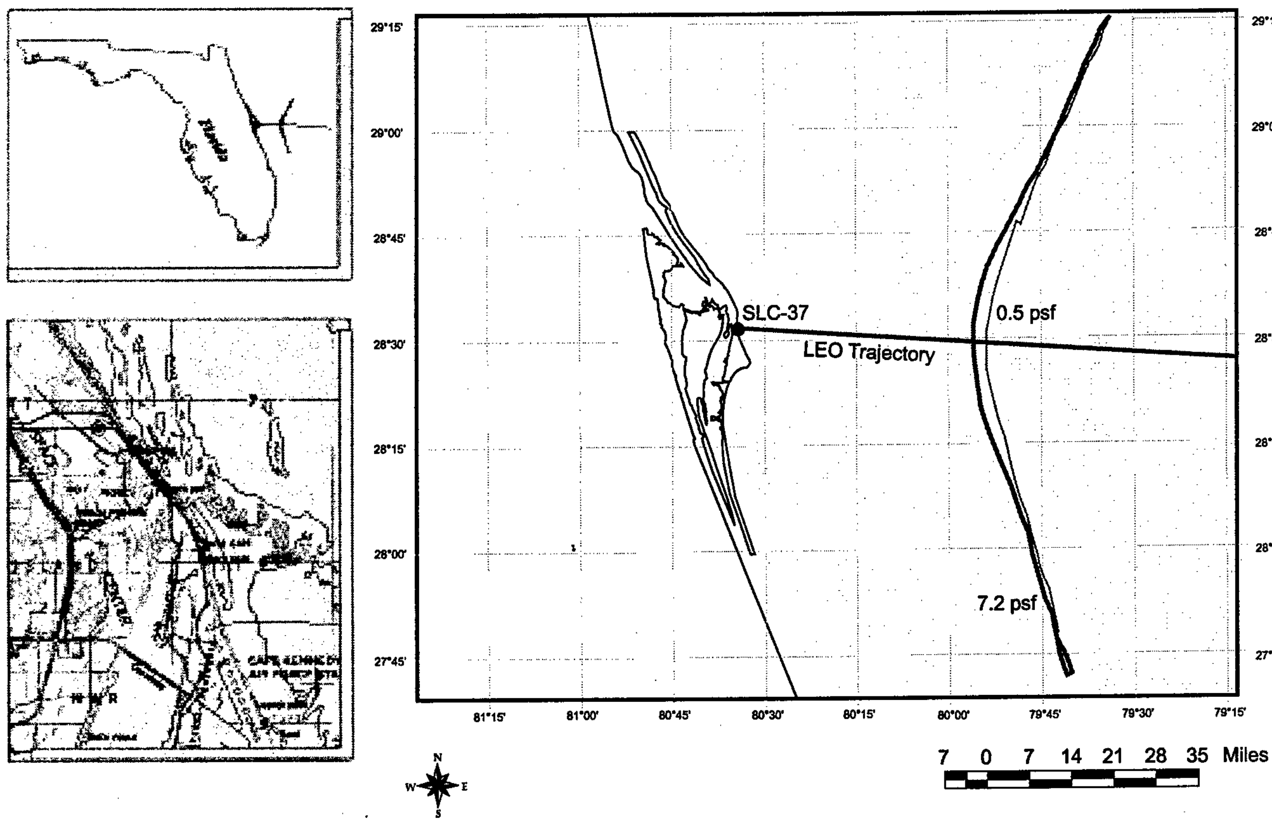

EXPLANATION

psf = pounds per square foot

Sonic Boom Footprint
Delta IV M+ (5, 4) (LEO)
CCAFS, Florida

Figure 4.12-15

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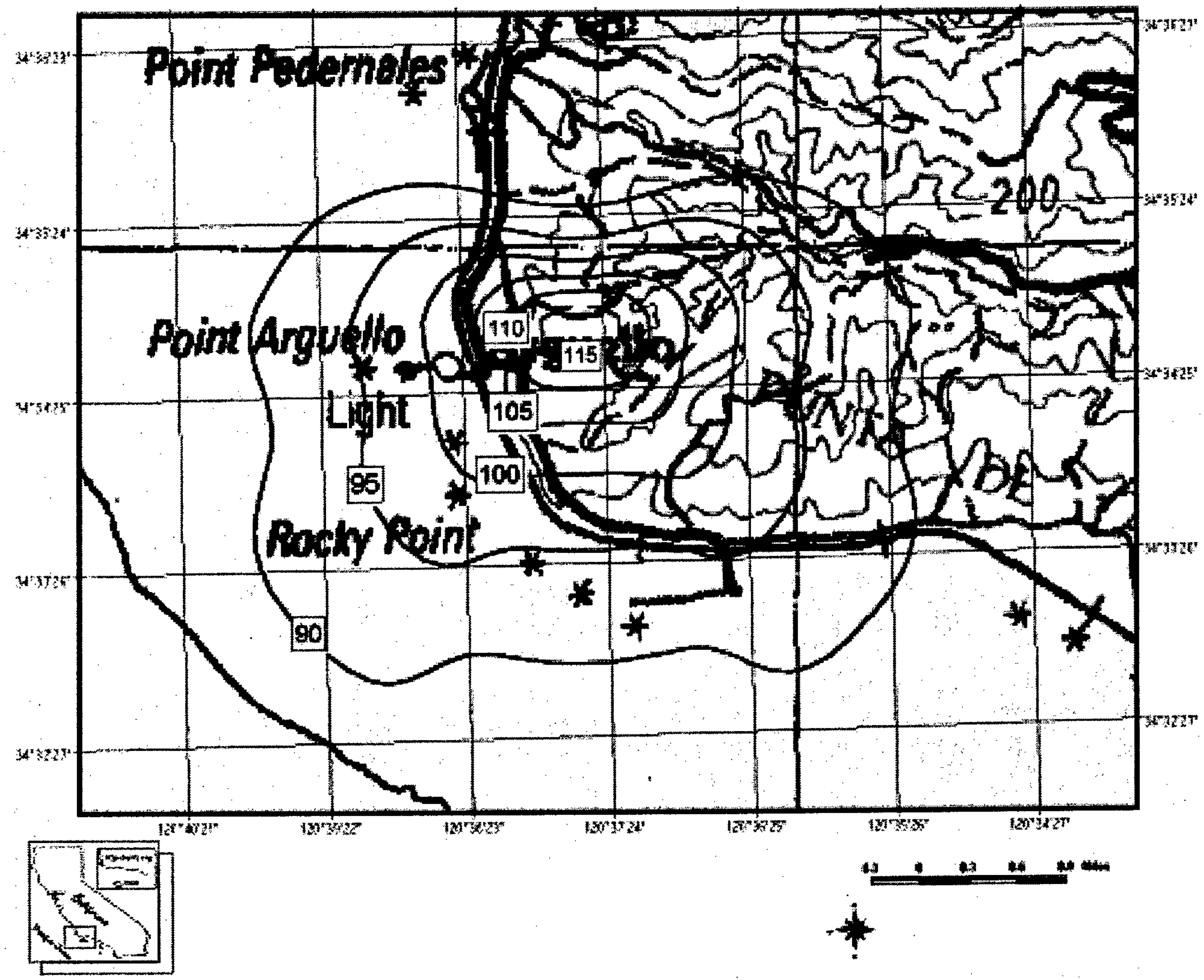
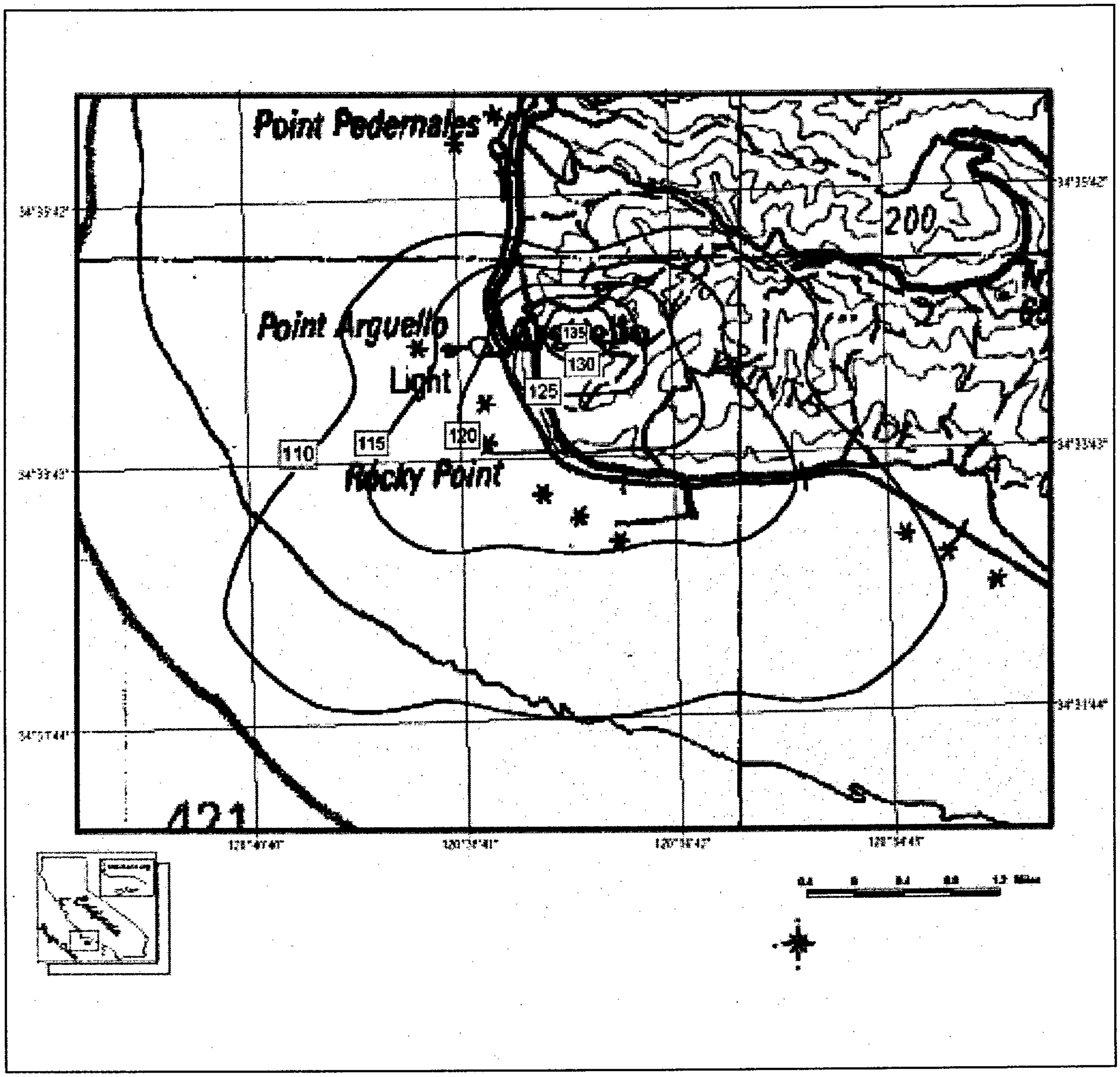


EXPLANATION

115 = 5-dBA Contour Intervals

On-Pad A-Weighted Sound Pressure Level, Delta IV M+ (5, 4) (LEO) Vandenberg AFB, California

Figure 4.12-16



EXPLANATION

135 = 5-dB Contour Intervals

On-Pad Overall Sound Pressure Level Delta IV M+ (5, 4) Vandenberg AFB, California

Figure 4.12-17

The direction of sound would be set by the launch pad configuration, so on-pad noise contours for all vehicles of this configuration would be similar to those shown. The noise levels would generally be two to three dB lower than those from an HLV.

In-Flight Rocket Noise. Figure 4.12-18 shows the A-weighted sound levels for in-flight noise from a Delta IV M+(5,4) on a LEO mission at a launch azimuth of 182 degrees. This represents the maximum level that would occur during the course of a launch after the vehicle is clear of the pad. The contours would be approximately circular, with a bulge at lower levels in the direction of the launch. This bulge, which would always be over the ocean, would change with different azimuths, but would involve lower levels that are not important for impact analysis.

The A-weighted levels at the nearest communities would be in the 80 dB range, louder than the noise of a passing automobile (65 to 70 dBA) and less than that of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level would not cause adverse impact. SEL has been computed for this launch and would be about 13 dB higher than the AWSPL. The event duration would last approximately 20 seconds. Launch noise would likely be audible for a longer period, but the total time involved would not be great enough to cause significant impacts.

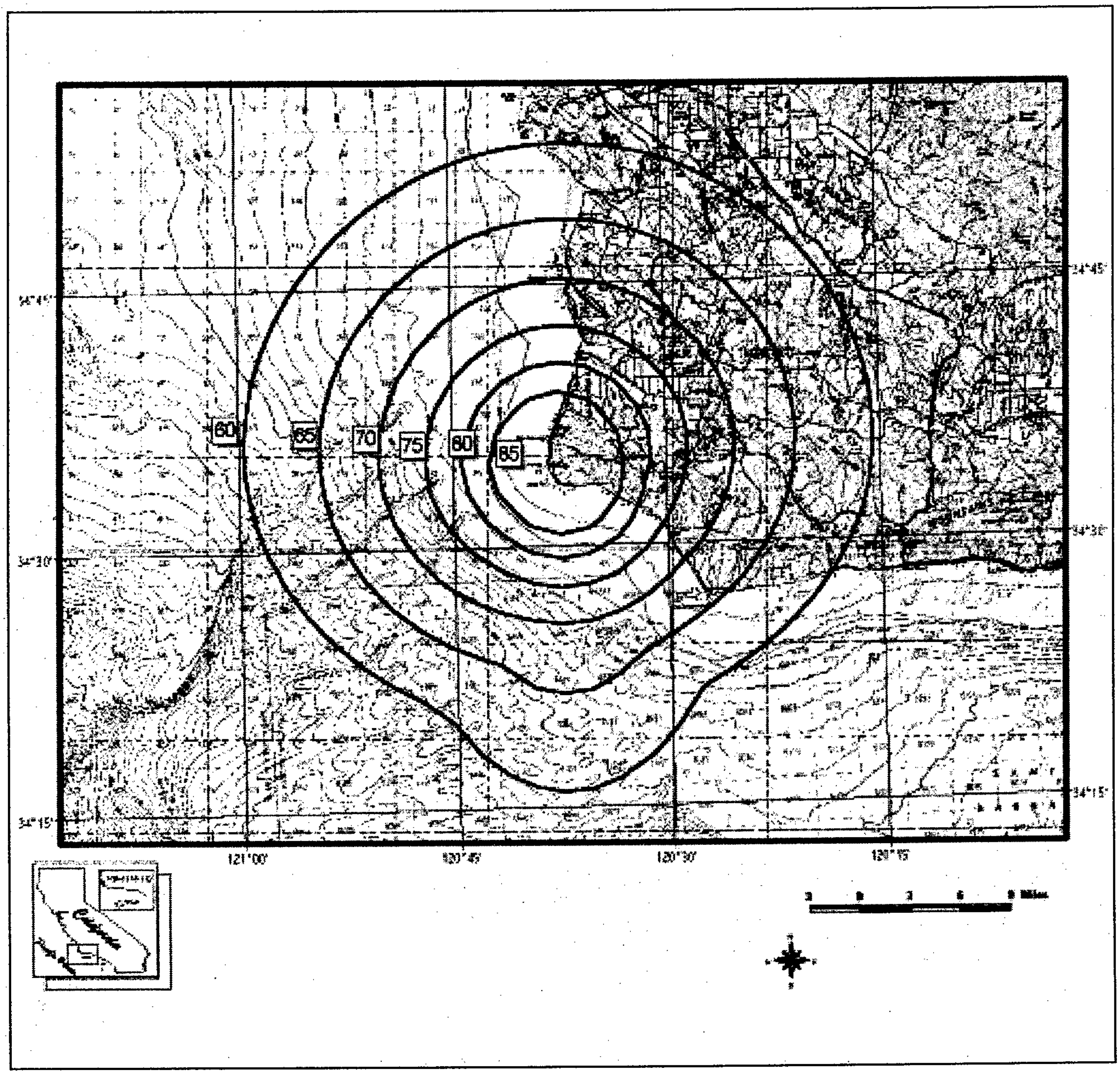
Figure 4.12-19 shows the overall sound pressure level for this launch. The higher-level contours would be approximately circular, so launch azimuth is not important. The OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, would be limited to a radius of approximately 2.8 miles from the launch site. This area does not contain residential communities, and most of the land area affected would be within the Vandenberg AFB boundary. The overall level at the nearest residential communities would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

Both the A-weighted and overall sound pressure levels for this launch would be 2 to 3 dB lower than the corresponding levels from the HLVs.

Sonic Boom. Figure 4.12-20 shows the sonic boom footprint for this launch. The maximum overpressure would be 7.2 psf, and would cover an area too small to be seen in the figure.

The lowest contour value drawn would be 0.5 psf. This footprint would be aligned with the launch azimuth and would fall into the Pacific Ocean, well offshore. Launch azimuths for the Delta IV-M+(5,4) would fall within the 140 to 201 degree range shown in the 1998 FEIS, so that sonic boom footprints would usually be entirely over the Pacific Ocean. Potentially, the edge of a boom footprint could intercept the mainland for azimuths near the eastern limit but sonic booms in this region would be attenuated by distance and ground effects, and would tend to sound more like distant thunder than an actual sonic boom.

Figure 4.12-20 shows that San Miguel Island and the far western portion of Santa Rosa Island would lie within the sonic boom footprint. For this particular launch, the boom would be below 1 psf, a level not usually expected to cause adverse effects, but other launch azimuths and missions could result in higher amplitude booms affecting these islands. As noted in Section 3.12, such sonic booms occur routinely from current launch activities at Vandenberg AFB. Potential impacts from these activities on wildlife on the Channel Islands and in the Pacific Ocean are discussed in Section 4.14.

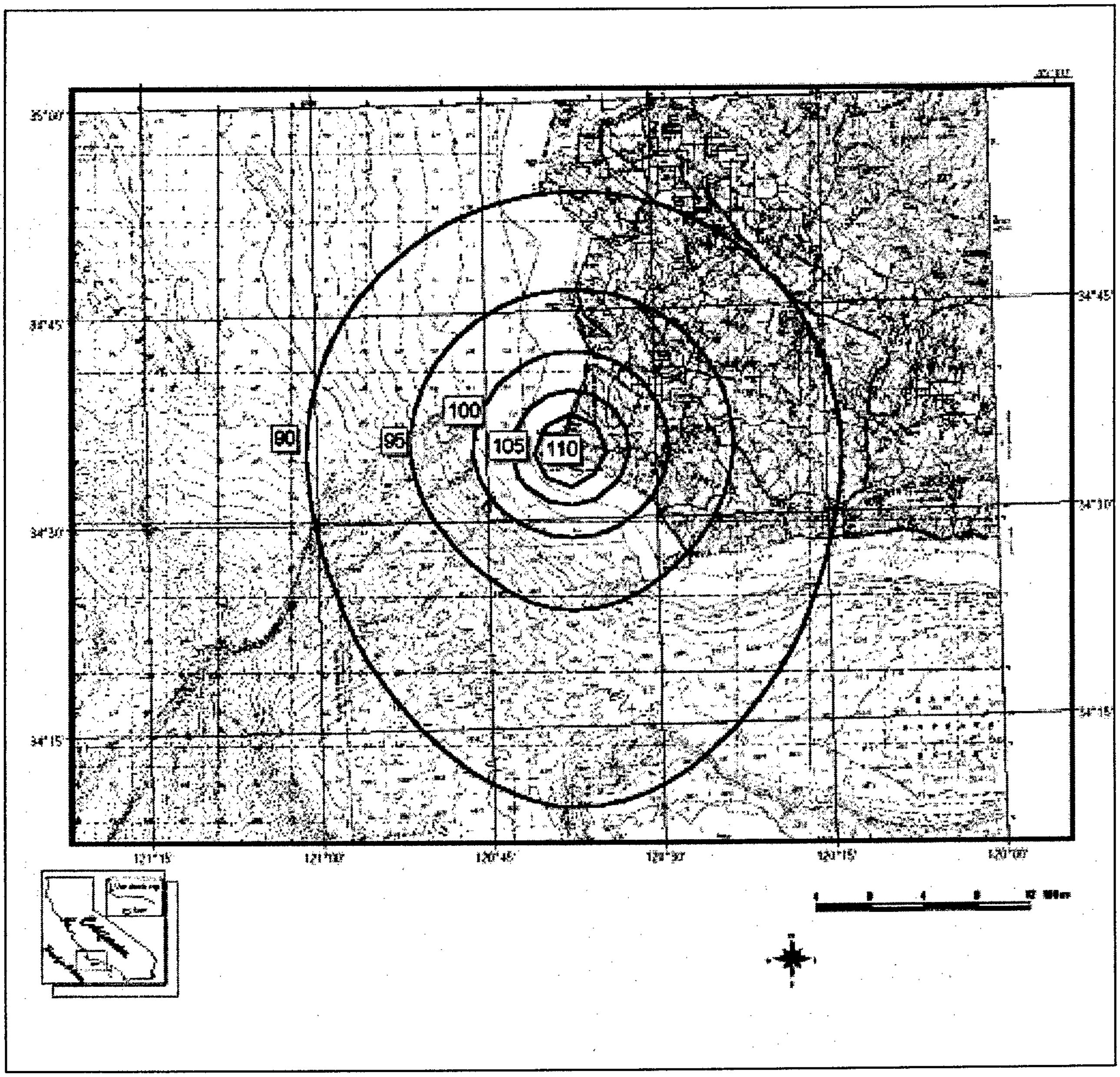


EXPLANATION

$\boxed{85}$ = 5-dBA Contour Intervals

In-Flight A-Weighted Sound Pressure Level Delta IV M+ (5, 4) (LEO) Vandenberg AFB, California

Figure 4.12-18

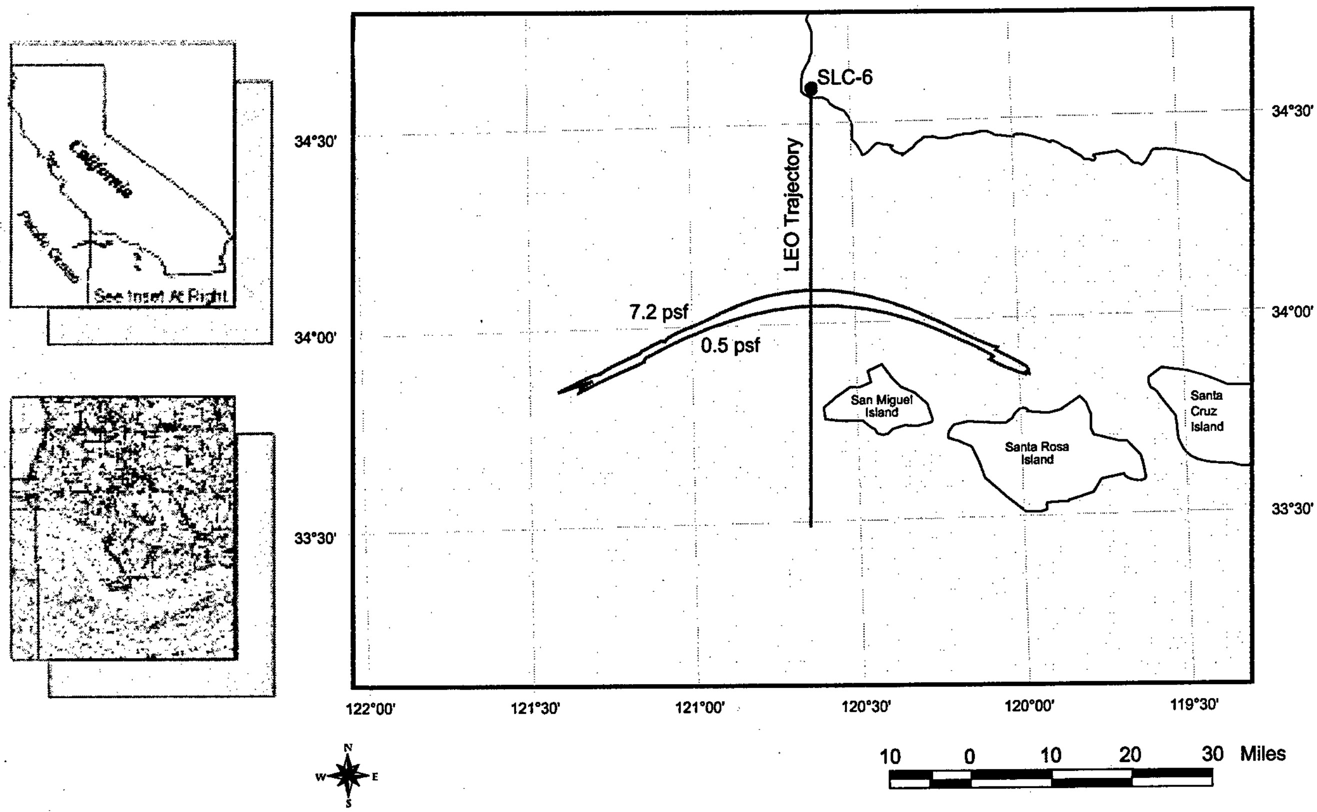


EXPLANATION

$\boxed{110}$ = 5-dB Contour Intervals

In-Flight Overall Sound Pressure Level Delta IV M+ (5, 4) (LEO) Vandenberg AFB, California

Figure 4.12-19



EXPLANATION

psf = pounds per square foot

Sonic Boom Footprint Delta IV M+ (5, 4) (LEO) Vandenberg AFB, California

Figure 4.12-20

The sonic boom footprint for this vehicle configuration would be similar to that for the other configurations associated with the No-Action Alternative. The HLVs in the No-Action Alternative would have a maximum sonic boom overpressure approximately 5 percent larger than that of the vehicles in the Proposed Action.

Underwater Penetration of Sonic Boom. The maximum overpressures at various depths for the various types of launches of the Delta IV M+(5,4) from Vandenberg AFB would be similar to the values observed for these launches from CCAFS. For launches from Vandenberg AFB, the maximum overpressure near the sea level would be slightly higher for the edge boom and slightly lower for the carpet boom than corresponding launches from CCAFS. No significant impacts are expected to occur from the underwater penetration of sonic booms.

4.12.1.3 Cumulative Impacts

Cumulative impacts of noise are quantified by the Ld_n, which has been shown to correlate well with adverse community impacts for regularly occurring events, even down to one or two per day. Rocket launches from both CCAFS and Vandenberg AFB are much less frequent than that, so corresponding Ld_n values would not be meaningful. As a result, noise and sonic booms from the Proposed Action would not add in a cumulative fashion to other ongoing noise activities in the vicinity of the base. Rather, EELV program launches would be observed as single events by receptors in the vicinity of the launches.

The difference between the number of launches under the Proposed Action and those of the No-Action Alternative would be approximately one per launch site per year. This difference would not have a cumulative noise effect.

EELV program launches would not occur at the same time as other launches at the same base. Rather, days or weeks would typically separate launch events. Therefore no cumulative noise or sonic boom effects would occur, either in the vicinity of the base, over water, or underwater. Similarly, launches at sites other than CCAFS and Vandenberg AFB would be too remote to cause cumulative effects.

In summary, launches of the Atlas V 551/552 system with SRMs and Delta IV M+(5,4) at the two bases would have no cumulative noise impacts in conjunction with any other action.

4.12.2 No-Action Alternative

This section summarizes material in Section 4.12 of the 1998 FEIS. Noise effects and sonic booms from the No-Action Alternative vehicles were computed in the 1998 FEIS, using RNOISE and PCBoom3, the same models used in the current analysis. This alternative will occur whether or not the Proposed Action is implemented.

4.12.2.1 Cape Canaveral Air Force Station

On-Pad and In-Flight Rocket Noise. On-pad and in-flight noise for the No-Action Alternative at CCAFS have patterns similar to those shown for the Proposed Action in Figures 4.12-1 through 4.12-4, and Figures 4.12-11 through 4.12-14. Because of their lower thrust, the Atlas V 300/400 and Delta IV M vehicles would generate noise levels about 3 dB lower than noise levels generated by the vehicles in the Proposed Action, but the Atlas V Heavy and

Delta IV H vehicles will generate noise levels 2 to 3 dB higher than the vehicles in the Proposed Action.

Based on the loudest events, the potential impact of the No-Action Alternative will be in the same range as that of the Proposed Action. The noise levels of the MLVs would be less with the No-Action Alternative than they will be with the Proposed Action, but the higher heavy vehicle noise levels will be the same in either case. With the No-Action Alternative, maximum A-weighted sound pressure levels in the closest communities will be comparable to or less than noise levels from heavy trucks, and will have an effective duration of about 20 seconds per launch. Overall sound pressure levels in communities will be below those for which structural damage will be expected.

Sonic Boom. Sonic boom footprints for the No-Action Alternative will be similar in character to those shown for the Proposed Action in Figures 4.12-5 and 4.12-15. Because of the difference in vehicle sizes, the magnitude of the peak overpressures will vary somewhat. The variation in pressure is expected to be of the magnitude of 10 percent, which does not represent a significant difference in potential impact. The largest booms will be slightly higher than those associated with the MLVs evaluated under the Proposed Action. All booms will occur over the Atlantic Ocean. Effects of sonic boom penetration underwater will also be similar to those described under the Proposed Action.

4.12.2.2 Vandenberg AFB

On-Pad and In-Flight Rocket Noise. On-pad and in-flight noise from the No-Action Alternative at Vandenberg AFB will have patterns similar to those shown for the Proposed Action in Figures 4.12-6 through 4.12-9, and Figures 4.12-16 through 4.12-19. Because of their lower thrust, the Atlas V 300/400 and Delta IV M vehicles would generate noise levels approximately 3 dB lower than noise levels generated by the vehicles in the Proposed Action, but the Atlas V Heavy and Delta IV H vehicles will generate noise levels 2 to 3 dB higher than the vehicles in the Proposed Action.

Based on the potential impact of the loudest events, the potential impact of the No-Action Alternative will be in the same range as that of the Proposed Action. The noise levels of the MLVs will be less with the No-Action Alternative than with the Proposed Action, but the higher heavy vehicle noise levels will be the same in either case. With the No-Action Alternative, maximum A-weighted sound pressure levels in the closest communities to Vandenberg AFB will also be comparable to or less than noise levels from heavy trucks, and will have an effective duration of about 20 seconds per launch. Overall sound pressure levels in communities will be below those for which structural damage would be expected.

Sonic Boom. Sonic boom footprints for the No-Action Alternative will be similar in character to those shown for the Proposed Action in Figures 4.12-10 and 4.12-20. Because of the difference in vehicle sizes, the magnitude of the peak overpressures will vary somewhat. This variation in pressure is of the magnitude of 10 percent, which does not represent a significant difference in potential impact. The largest booms will be slightly higher than those associated with the medium vehicles evaluated under the Proposed Action. All booms will be over the Pacific Ocean. The potential for sonic booms to adversely impact the Channel Islands is similar to that for the Proposed Action. Effects of sonic boom penetration underwater will also be similar to those of the Proposed Action.

4.13 Orbital Debris

This section describes the impacts attributable to orbital debris as a result of implementing the Proposed Action (Section 4.13.1) and the No-Action Alternative (Section 4.13.2).

4.13.1 Proposed Action

The Proposed Action includes both the Atlas V and Delta IV systems. It is estimated that 566 upper stages could be launched from 2001 through 2020 under the increased launch rate analyzed in this FSEIS. That would be the expected increase to combined impacts previously analyzed in the 1998 FEIS. Measures presented in this section would minimize effects to the space environment.

The proposed addition of SRMs to EELV program vehicles (including the use of larger SRMs on Delta IV vehicles) would not contribute to any change in orbital or deorbiting debris from that analyzed in the 1998 FEIS. The SRMs would burn out and drop long before the vehicles reach Earth orbit, as would the payload fairing (shroud) that protects the satellite during its flight through the atmosphere. However, the projected increase in the commercial launch rate for EELV program vehicles using SRMs would lead to an overall nominal increase in the use of CUSs. The CUSs are the only EELV program components that have the potential to contribute to orbiting and deorbiting debris. Table 2.1-1 indicates a total of 566 launches between 2001 and 2020 under the Proposed Action, an increase of 94 launches from the No-Action Alternative.

Since the 1998 FEIS was completed, LMC has opted not to use the SUSs (referred to in "Concept A," in the 1998 FEIS) that were to use monomethyl hydrazine, N_2O_4, and anhydrous hydrazine. Boeing is no longer planning to offer a Delta IV small-lift vehicle; therefore, the HUS and Star 48B referred to in the 1998 FEIS would no longer potentially contribute to orbiting or deorbiting debris. The HUS, as described in the 1998 FEIS, was to contain A-50 and N_2O_4, while the Star 48B was an SRM containing NH_4ClO_4, Al, and HTPB. Therefore, any orbital debris issues associated with any of the aforementioned upper stages would no longer be considered under the Proposed Action.

The environmental consequences of orbiting and deorbiting debris from additional payloads potentially launched on EELV program vehicles would be addressed under separate NEPA documentation for each of the satellite programs, as required.

Orbital debris and deorbiting debris result in impacts to the global commons, so launches from CCAFS and Vandenberg AFB would be treated as a single source, unless they populate certain orbits preferentially.

4.13.1.1 Atlas V System

For all Atlas V system missions, the upper stage would be placed in a disposal orbit. Disposal orbits are orbits that, as a result of current and projected missions and technologies, are effectively useless except as regions of the space environment where spent hardware can be disposed of without impacting current or projected space systems. The Atlas V system upper stage would also be vented to preclude debris creation resulting from explosive overpressure. These techniques are in accordance with the EELV program System Performance Document (1998 FEIS, Appendix E) and international agreements on space debris minimization.

4.13.1.2 Delta IV System

For all Delta IV missions, the upper stage would be placed in a disposal orbit. For GTO profiles, the upper stage would be placed in an orbit whose apogee would be at least 100 nautical miles lower than the spacecraft orbit. For a GEO case, the upper stage would be placed in a disposal orbit with an apogee and inclination that varies slightly from the GEO orbit.

Both the LO_2/H_2 and the ACS propellant would be vented or depleted from the upper stage to minimize the potential for breakup of the stage from explosive overpressure. The Delta IV system procedures would comply with EELV program System Performance Document (SPD) requirements (1998 FEIS, Appendix E) and international agreements on space debris minimization.

4.13.1.3 Cumulative Impacts

Implementation of the Proposed Action would not likely change the total number of worldwide space launches between 2001 and 2020. The Proposed Action would increase the total EELV program launches to 566 from 472 in the No-Action Alternative. Given the increased launch rate, there would be a nominal increase in orbital debris from domestic vehicles; however, overall there would be no significant global effect on orbital debris. As a result, no cumulative impacts would be incurred from the implementation of the Proposed Action. Any increase in orbital debris as a direct result of EELV program launches would be mitigated, as explained in Sections 4.13.1.1 and 4.13.1.2.

4.13.2 No-Action Alternative

The contribution to orbiting and deorbiting debris from the No-Action Alternative was described in Chapter 4.13 of the 1998 FEIS. Fewer launches (534) were analyzed in the 1998 FEIS than under this FSEIS Proposed Action (566), so the overall contribution to the number of upper stages left in orbit was less than the number analyzed for this FSEIS. This alternative will occur whether or not the Proposed Action is implemented.

Since the 1998 FEIS was completed, LMC has opted not to use the SUSs (referred to in "Concept A," in the 1998 FEIS) that were to use monomethyl hydrazine, N_2O_4, and anhydrous hydrazine. Boeing is no longer planning to offer a Delta IV small-lift vehicle; therefore, the HUS and Star 48B referred to in the 1998 FEIS will no longer potentially contribute to orbiting or deorbiting debris. The HUS, as described in the 1998 FEIS, was to contain Aerozine-50 and N_2O_4; while the Star 48B was an SRM containing NH_4ClO_4, Al, and HTPB. As a result, any orbital debris issues associated with any of the aforementioned upper stages will no longer be considered under the No-Action Alternative.

4.14 Biological Resources

This section describes the potential environmental consequences of the Proposed Action (Section 4.14.1) and the No-Action Alternative (Section 4.14.2) on biological resources with separate discussions on vegetation, wildlife, essential fish habitat, threatened and endangered species and sensitive habitats for each launch site and each launch program. Cumulative impacts are also discussed.

4.14.1 Proposed Action

The Proposed Action includes both the Atlas V and Delta IV systems. The EELV program launch activities with the potential to affect biological resources include:

- Noise associated with launches
- Sonic booms
- Extreme heat and fire in the vicinity of the launch pad
- Entrainment of harmful chemicals in launch and post-launch water
- Deposition of chemicals from the SRM exhaust
- Dropping the booster and payload farings into the ocean

Minor temporary disturbances are expected during the small-scale construction activities associated with the Proposed Action.

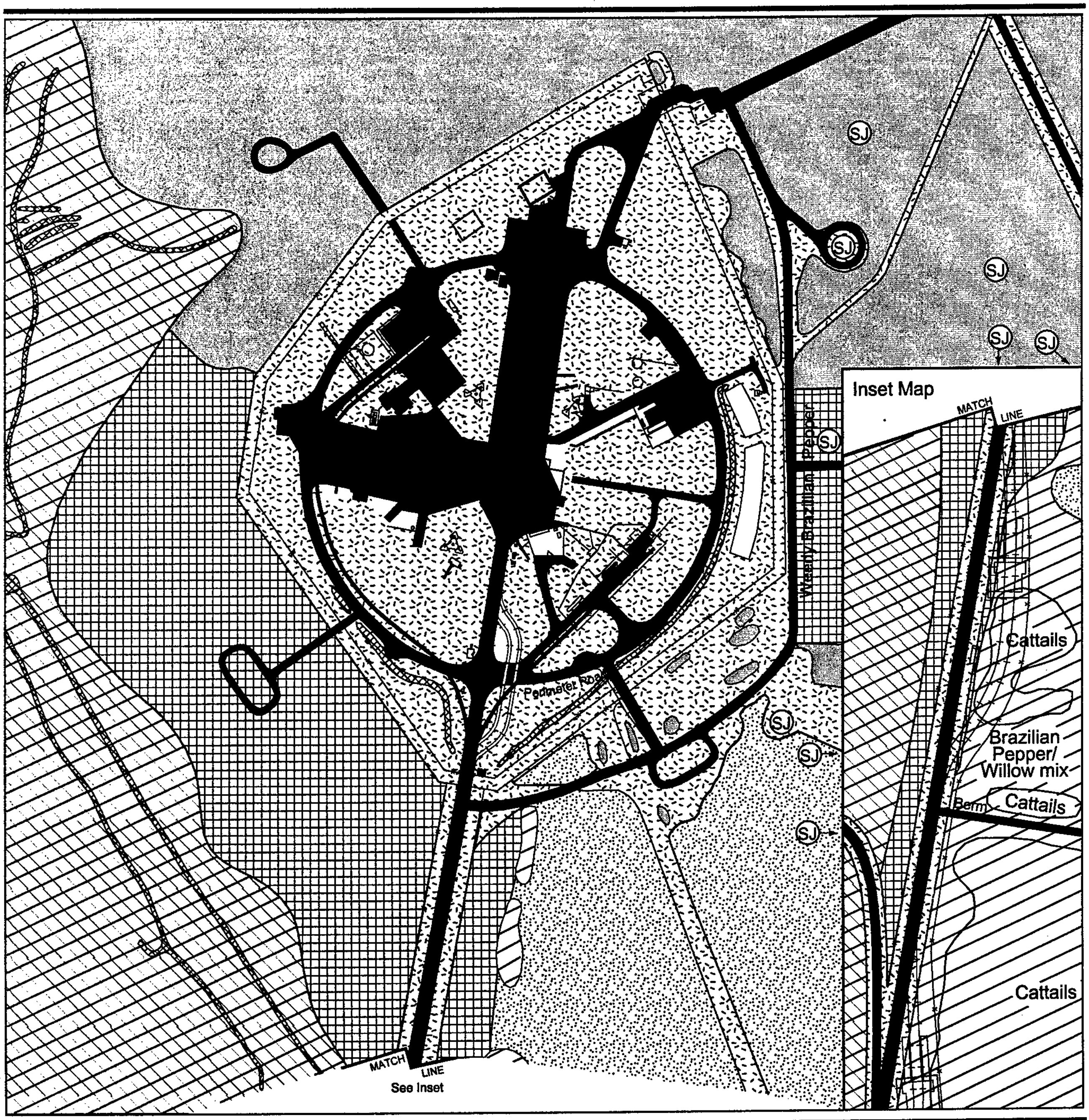
4.14.1.1 Cape Canaveral Air Force Station

4.14.1.1.1 Atlas V System

At CCAFS, potential impacts to biological resources from the use of SRMs on the Atlas V system lift vehicle in the Proposed Action would occur from launches and launch-related activities at SLC-41. Increased acid deposition from SRM exhaust in the Proposed Action would be anticipated, relative to conditions described in the 1998 FEIS (No-Action Alternative). Monitoring data from previous SRM-assisted launches, including Delta II and Titan IVB lift vehicles, suggest that impacts would be minimal, as described below. No physical alteration of wetlands or other critical habitat would be anticipated for the Proposed Action. Figure 4.14-1 shows the locations of vegetation and sensitive habitats associated with SLC-41.

Vegetation. The impact to vegetation at CCAFS from the Proposed Action would be minimal. The vegetation surrounding SLC-41 is a mixture of mowed grasses and forbs. The area is currently affected by deposition of HCl and Al_2O_3 associated with past launches. The vegetation community composition has adjusted to these conditions by the elimination of species sensitive to acidic deposition. Dune and strand vegetation are particularly sensitive to the near-field efforts of the exhaust cloud. Substantial recovery would occur within approximately 6 months (Schmalzer, et al., 1988).

The prediction of the level of impacts resulting from use of the Proposed Action Atlas V vehicles is based in part on observed impacts of previous launches that used SRMs. Launches of 44 Atlas II, Delta II, and Titan IVB lift vehicles were monitored for environmental effects between 1995 and 1997 (Schmalzer, et al.,1998). Observed impacts to vegetation occurred for a maximum distance of between 30 and 800 meters from the launch pad. The most common effects were foliar spotting on plants consistent with acidic deposition, and deposition of sand on nearby plants from the exhaust turbulence. HCl was identified as the primary phytotoxicant, because the non-toxicity of Al_2O_3 has been demonstrated in laboratory tests (USAF, 1991). In laboratory toxicity testing, it has been shown that Al_2O_3 was relatively insoluble at ambient pH of surface waters on and adjacent to CCAFS. Because there would be only a brief period of decreased pH associated with observed launches of all types, Al_2O_3 deposition would not be expected to contribute to aluminum toxicity in surface waters at CCAFS (Schmalzer, et al., 1998).



EXPLANATION

- Security Fence
- Scrub Jay territories
- Developed
- Drainage ditch (open water)
- Barren
- Brazillian Pepper
- Maritime Hammock
- Mowed or open grassland
- Oak or Coastal Scrub (FL Scrub Jay habitat)
- Saltwater marsh
- Wetland

0 150 300 Feet

Source: Aerial photograph, Smith Environmental Services, 1997; Earth Tech, 1997; site visit, 1997.

SLC-41 Vegetation and Sensitive Habitat CCAFS, Florida

Figure 4.14-1

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Other testing (Heck, et al., 1984) of plant exposure to large doses of Al_2O_3 showed no injury or growth inhibition to the plants.

In addition, monitoring reports frequently noted that the field scientists believed that the acidic and particulate deposition observed was not of sufficient intensity to cause long-term damage to vegetation. Also, effects were confined to near-field deposition, with no significant impacts, including community-level changes, occurring from far-field deposition (Schmalzer, et al., 1998). It is anticipated that impacts to vegetation from the Proposed Action would be similarly limited.

In addition to using monitoring data from similar programs to predict launch-related effects, modeling was used. REEDM, discussed in Appendix R, was used to predict gravitational deposition resulting from SRM-augmented Atlas V launches in the Proposed Action. Peak HCl deposition for the Atlas V with five SRMs was predicted to be approximately 13,080 milligrams per square meter (mg/m^2) at about 1,000 from the launch pad, and decreasing thereafter, as described in Appendix R. Although these levels of deposition are above ambient conditions, significant impacts are not expected to occur because the conditions under which these impacts would occur (i.e., rain events) are infrequent. Launches during rainfall are relatively rare because of launch criteria developed to protect against lightening strikes.

Launch effects on vegetation could also include burning of areas adjacent to the launch duct and defoliation resulting from heat. Near-field deposition of debris from launches could also damage vegetation. Areas affected by the launch pad deluge and washdown water and HC1 vapor cloud could suffer damage from the hot water, but are not expected to result in any changes that would affect the long-term composition of the vegetation community.

An anomaly on the launch pad could produce extreme heat, fire, and flying debris that could damage adjacent vegetation (see Wildlife, below). Damaged vegetation resulting from an anomaly would be expected to regrow within the same growing season, because no lingering effects would be present. The most sensitive nearby vegetative community, dune strand, was observed to sustain damage from a shuttle launch at KSC (with significantly higher exhaust and flame than for the Proposed Action), but it recovered within 6 months.

Wildlife. The following discussion of potential impacts to wildlife is supplemented with the section on threatened and endangered species that follows. No external facility modifications, including alterations to roads, are envisioned for the Atlas V part of the Proposed Action at CCAFS, so potential impacts would result only from launches and launch-related activities.

It has been observed that the visual and noise disturbance from pre-launch patrol aircraft overflight often creates more disturbance than the launch itself (Bowles, et al., 1991). Pre-launch patrol aircraft could temporarily disrupt nesting or feeding birds along the Banana River if flown below 550 feet above ground level (AGL). The 550-foot AGL zone has been shown to account for most wildlife reaction to visual stimuli (Bowles, et al., 1991; Lamp, 1987). A report to Congress in 1992 by the U.S. Forest Service reviewed existing literature assessing wildlife impacts from aircraft overflight effects. The report concluded that, although aircraft overflights are initially startling, animals generally adapt by habituating behaviorally and physiologically to the challenge. The report concluded that

overflights generally pose negligible risks to wildlife. Therefore, effects of patrol aircraft activities on wildlife are expected to be negligible.

Potential direct launch effects on the wildlife in the near-field area include incidental death from heat, loss of hearing to various degrees, and temporary disruption of life patterns such as feeding, roosting, and moving about. Animals most likely to be affected include birds (great blue heron, downy and red-bellied woodpecker, mourning dove, housewren), and less mobile terrestrial species such as small mammals (armadillo, weasel, Florida mouse), and herpifauna (snakes, gopher tortoise). Because SLC-41 is near areas currently being used for launches, resident species sensitive to these disturbances are not likely to be found in the nearby vicinity. Animal species that stray into the area during a launch could be killed, but the effects to resident populations from this loss would be negligible.

Wild animals, especially terrestrial mammals (armadillo, bobcat, feral hog, white-tailed deer, raccoon) and birds (great blue heron, downy and red-bellied woodpecker, mourning dove, housewren) exposed to sudden intense noise could panic and injure themselves or their young; however, this is usually the result of the noise in association with the appearance of something perceived by the animals as a pursuit threat. Launch noise from the proposed Atlas V system with SRMs is not expected to cause more than a temporary startle-response. Any loss or injury as a result of this startle response would be incidental and not a population-wide effect.

Research on noise thresholds of representative birds and mammals was summarized by Schmalzer, et al. (1998). Based on a review of the available literature, a noise threshold of 95 dBA was selected as the limit below which such basic activities as mating and nesting would not likely be affected. Noise modeling described in Section 4.12 indicates that the 95 dBA level at launch may extend out slightly more than one mile from SLC-41, subject to meteorological conditions at launch. It is anticipated that temporary disturbance to wildlife would be confined to this area. Most importantly, it must be noted that noise levels associated with the Proposed Action have been predicted to be 2 to 3 dB lower than the noise associated with the HLV previously analyzed in the 1998 FEIS.

Noise associated with SRM-augmented Atlas V launches could startle many species within the area, including the Indian River habitat. No substantive increases of impacts to wildlife are expected over the No-Action Alternative, based on the infrequent and brief occurrence of launch noise resulting from the Proposed Action. Sonic booms created by the proposed Atlas V vehicles would occur over the open Atlantic Ocean. The effects of a sonic boom on whales or other open ocean species are not well known. Peak sightings of northern right whales off the Cape occur during the spring and fall migrations. The sonic booms resulting from the Proposed Action Atlas V, however, would be infrequent and the marine species in the ocean's surface waters are present in low densities. The sonic boom footprint has been predicted to occur more than 30 miles east of CCAFS over the open ocean; thus, the sonic booms from Atlas V launches are not expected to affect adversely the survival of any marine species, as further discussed below.

A small amount of Al_2O_3 would be present in the SRMs when they fall into the ocean. Upper stages are more likely to incinerate on reentry. If released, the material would be diluted by the vast amounts of sea water and would not be expected to affect marine species. The chance that the falling stages from Atlas V vehicle launches would result in significant

impacts to marine organisms is unlikely given the extent of the open ocean and the dispersed nature of many marine organisms in open ocean areas. Under nominal launch conditions, the stages would fall a minimum of 20 miles offshore, depending on local meteorological conditions. The discarded stages would likely act as hard-bottom substrate and artificial reefs, enhancing marine diversity.

An anomaly on the launch pad would also present potential impacts to biological resources as a result of the possibility of extreme heat and fire, and from percussive effects of the explosion. The explosion could result in a loss of wildlife found adjacent to the launch pad or within debris impact areas. Birds, reptiles, and small mammals (as listed above) would be most at risk. Potential fires started from the anomaly could result in a temporary loss of habitat and mortality of less mobile species. Modeling of debris deposition resulting from a launch anomaly (Section 4.13) suggests that vehicle parts would be distributed over an area approximately 1.25 miles in diameter if the vehicle destruct occurred at the SLC-41 launch pad, based on the mean annual wind profile. An explosion after the vehicle was airborne is predicted to distribute the material across the open water, over an area of approximately 1.5 to 2 square miles. Based on the large volume of sea water and circulation-driven dilution of hazardous substances, it would be unlikely that impacts to wildlife would occur. Fire resulting from an anomaly at SLC-41 would be limited to areas adjacent to the launch pad because of the amount of surrounding water.

It has been estimated that the chances of an anomaly are in the range of 2 percent per launch. Furthermore, the 10 percent increase in average annual launch rate of the Proposed Action over the No-Action Alternative indicates that there would be very low potential for impacts from anomalies. Additionally, a Health and Safety Plan (see Section 4.7) is in place that would lead to a rapid emergency response to any onsite fire.

Essential Fish Habitat and Managed Marine Species. Debris from launch failures has the potential to adversely affect managed fish species and their habitats in the vicinity of the project area. Ammonium perchlorate in the SRM fuel used in the Proposed Action contains chemicals that, in high concentrations, have the potential to result in adverse impacts to the marine environment. There are 206 fish species that inhabit the waters in the vicinity of the project area that are currently managed by regional fishery management councils. These species and their habitats are required to be addressed regarding potential adverse effects from the Proposed Action in this SEIS. Consultation with the NMFS has been initiated and a technical report on EFH is being prepared. A copy of the correspondence initiating the consultation with NMFS is in Appendix P.

Threatened and Endangered Species. As stated above, no external facility alterations are proposed as a result of using SRMs on Atlas V vehicles. Thus, impacts to threatened and endangered species, if any, could occur at CCAFS only from launch-related activities. Observations of conditions at the launch facilities provided evidence that the extent of impact from launches similar to the Proposed Action would be minimal to listed species at and near the launch site. Potential effects to threatened and endangered species in critical habitats are further discussed in the section below on Sensitive Habitats.

Four Titan IVB launches (which use substantially larger SRMs than the proposed Atlas V SRMs) were monitored in 1990 from SLC-40 and SLC-41 for their effect on the protected Florida Scrub Jay. No mortality was observed. All banded individuals were located 4 hours

after the launches, and none showed signs of distress. Each responded to taped scrub jay calls played by investigators. Fire caused by one of the launches disrupted the scrub jays in the area; they exhibited unusual intensity and duration of scolding behavior. The birds avoided the burned area for approximately 1 month (Larson, et al., 1993). Additional monitoring of 44 launches at several sites on CCAFS, as described above, failed to identify significant impacts to scrub jays. Impacts of an anomaly, however, would be as described in the Wildlife section, and could affect scrub jay habitat.

Effects to sensitive birds in the nearby estuaries (wood stork and bald eagle) or shorelines (least tern and piping plover) would be similar to those described for wildlife. The launches are not expected to jeopardize the continued existence of any listed species as a result of the intermittent nature of the disturbance and the ability of wildlife to habituate to disturbance, or to return to normal behavior after a startle response.

Manatees are relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats (although their hearing is actually similar to that of pinnipeds) (Bullock, et al., 1980). Because manatees spend most of their time below the surface, and do not startle readily, no effect of aircraft or lift vehicle overflights on manatees would be expected (Bowles, et al., 1991). Additionally, manatee habitat is located to the west of the launch facility, away from the direction of sonic booms.

Sea turtle (mainly green and loggerhead sea turtles at CCAFS) adults and hatchlings are sensitive to artificial incandescent, metal halide, or high-pressure sodium lighting near their nesting beaches. The hatchlings use moonlight and starlight on the ocean water for directional guidance after emerging from the nest. If lighting inland is brighter than the offshore lights, sea turtles may become confused and head the wrong way, never reaching the water. A light management plan for SLC-41 to address the lighting configuration has been developed under the No-Action Alternative to prevent negative sea turtle impacts. No changes in this light management plan would be anticipated for the Proposed Action. The draft light management plan is being prepared for delivery to the USFWS, and includes standard elements, such as the use of low-pressure sodium lighting and onshore light alignment to minimize impacts to the sea turtle population.

Sensitive Habitats. As stated above, no physical disruption at CCAFS to wetlands or other sensitive habitats is anticipated as a result of implementing the Proposed Action, but potential impacts from launch-related activities must also be considered.

Effects to birds (brown pelican, roseate spoonbill, wood stork) using rookeries in the wetlands surrounding SLC-41 was discussed in the Wildlife section. Effects of noise and sonic booms as a result of SRM use were described in Wildlife, with the addition of potential impacts in the newly designated critical habitat for the northern right whale, as described in Section 3.14. The right whale habitat extends out from the shoreline approximately 5 nautical miles and includes waters averaging about 30 meters deep.

Sonic booms from the proposed Atlas V vehicles would be expected to occur over this habitat, but noise modeling discussed in Section 4.12 suggests that noise caused by MLVs for the Proposed Action would be similar to noise levels resulting from MLVs listed in the No-Action Alternative. It has been predicted that maximum pressure of the booms at the focus (apex) of the wave, which covers a small area, would slightly exceed 7 pounds per

square foot (psf) at the water surface, and would rapidly decrease with depth, reaching about 3 psf at 30 meters. Energy at the leading edge of the sonic boom wave, which covers a much larger area, would be significantly less than at the focus. This is consistent with the summaries provided by Richardson, et al. (1995) that report most energy from sonic booms generated over open water is reflected upward, with little underwater propagation. Richardson, et al. (1995) also report that standard reaction to sonic booms is a "startle" reflex that is soon over.

No documentation of harm to whales from sonic booms has been identified. Keevin and Hempen (1997) report, however, that impulses up to 5 pounds per square inch (psi) or 720 psf are considered to cause no impact to marine mammals. In addition, impulse values up to 10 psi (1,440 psf) could result in a "low incidence of trivial injuries", which does not include hearing loss. As a result, the sonic boom would be well below the level for potential harm, but lower noise levels could still cause a temporary threshold shift (change to an animal's threshold for noise levels that could provoke a response), although this level has not been well studied. Sonic booms, however, would not be frequent, and two additional sonic booms per year (over the No-Action Alternative) would not represent a substantial increase.

An anomaly on the launch pad, as described above for wildlife, would frighten nearby sensitive species that use the Indian and Banana Rivers (such as birds in rookeries and neotropical landbirds). Manatees, sea turtles, and other aquatic species would not be expected to be adversely affected by an anomaly.

No changes to the light management plan that was developed for the No-Action Alternative would be anticipated for implementation of the Proposed Action.

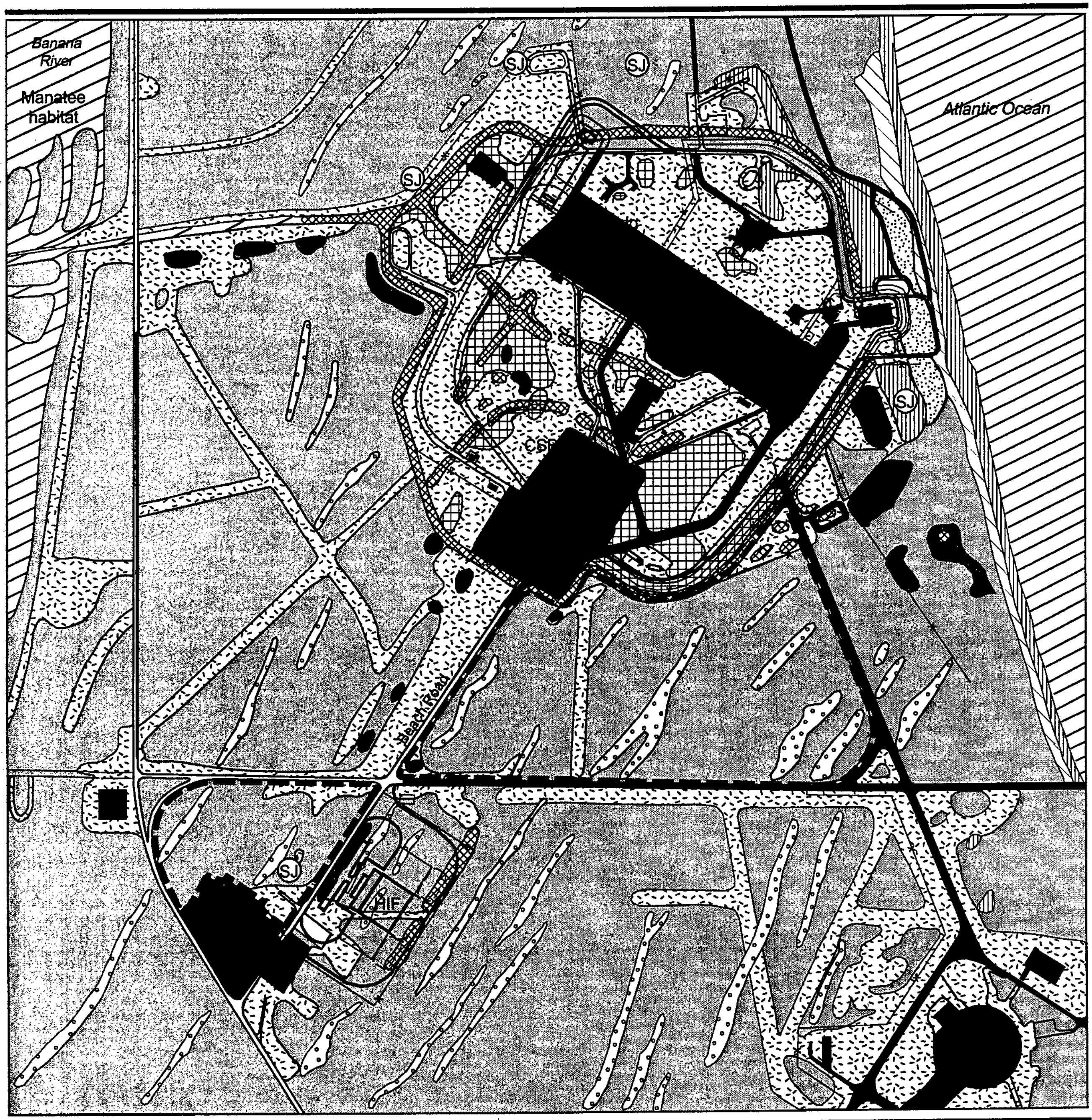
No wetland impacts are anticipated under the Proposed Action; thus, no mitigation would be required.

4.14.1.1.2 Delta IV System

At CCAFS, potential impacts to biological resources caused by the use of larger SRMs on Delta IV vehicles would occur from launch-related activities at SLC-37 and related construction at support facilities. Launch-related impacts, in addition to those associated with the No-Action Alternative, include two additional launches per year on average, as discussed in Section 2.0, and the increase in acid deposition caused by use of larger SRMs than those addressed in the 1998 FEIS. No physical alteration of wetlands or other critical habitat would be anticipated for the Proposed Action. Figure 4.14-2 shows the locations of vegetation and sensitive habitats associated with SLC-37.

Vegetation. The impact to vegetation from the use of larger SRMs would be similar to that described for the Atlas V system in Section 4.14.1.1.1. In addition, monitoring reports frequently noted that the field scientists observed that the acidic and particulate deposition was not of sufficient intensity to cause long-term damage to vegetation. Also, effects were confined to near-field deposition, with no significant impacts, including community-level changes, occurring from far-field deposition (Schmalzer, et al., 1998). It is anticipated that impacts to vegetation from the Proposed Action would be similarly limited.

The REEDM, discussed in Appendix R, was used to predict gravitational deposition resulting from Delta IV launches using larger SRMs. Peak HCl deposition resulting from



EXPLANATION

HIF Horizontal Integration Facility

FL Scrub Jay territories

Swale

Developed

Brazilian Pepper/ wax myrtle

Open water

Coastal dune vegetation

Coastal strand vegetation

Mowed or open grassland

Oak or Coastal Scrub (FL Scrub Jay habitat)

Open sand (Beach mouse habitat)

Palmettos

Wetlands/ wet areas

0 200 400 800 Feet

Source: Aerial photograph interpretation following site visit, 1997; Earth Tech, 1997.

SLC-37 Vegetation and Sensitive Habitat CCAFS, Florida

Figure 4.14-2

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the use of four SRMs was predicted to be 14,094 mg/m^2 at about 1,000 meters from the launch pad and decreasing with distance thereafter. Although these levels of deposition are well above ambient conditions, occurrence of the vapor clouds is transient and dispersion is rapid.

Launch effects on vegetation can also include burning of areas adjacent to the launch duct and defoliation resulting from heat and near-field deposition of debris from launches. IPS and post-launch washdown water would be used for the Delta IV at SLC-37 under the Proposed Action. Most of the HCl generated from the exhaust would settle at the site and be washed off with the washdown water. Generated runoff would be collected and retained at a lined pond onsite. An anomaly on the launch pad could produce extreme heat and fire, and flying debris, that could damage adjacent vegetation. Modeling of debris deposition resulting from a launch anomaly (Section 4.13) suggests that vehicle parts would be distributed over an area approximately 1.25 miles in diameter if the vehicle destruct occurred at the SLC-37 launch pad, based on the mean annual wind profile. An explosion that occurred after the vehicle was airborne is predicted to distribute the material over the open water, over an area of approximately 2 square miles. Based on the large volume of sea water and circulation-driven dilution of hazardous substances, it is unlikely that impacts to wildlife would occur. Fire resulting from an anomaly at SLC-37 would be limited to areas adjacent to the launch pad because of the amount of surrounding water.

It has been estimated that the chances of an anomaly are in the range of 2 percent per launch. This low failure rate indicates that there is limited potential of impacts from anomalies as a result of implementing the Proposed Action. Additionally, a Health and Safety Plan (see Section 4.7) is in place that would lead to a rapid emergency response to any onsite fire.

Wildlife. The following discussion of potential impacts to wildlife is augmented with the section regarding threatened and endangered species, below. The only external facility modifications at CCAFS that are included as part of the Delta IV portion of the Proposed Action would include access road paving at the SRS, as well as access road paving and a possible truck loading/unloading platform at the RIS. Because this construction would occur on land that is now landscaped lawn, the only impacts to biological resources from implementing the Proposed Action would be those associated with two additional Delta IV launches using larger SRMs.

Other potential impacts would involve launch-related activities including pre-launch overflights. The visual disturbance from two additional pre-launch patrol aircraft overflights per year (above the level in the No-Action Alternative) would be less than significant to onsite wildlife, as discussed in Section 4.14.1.1.1, Wildlife.

Direct launch effects on the wildlife, especially birds and small mammals, in the near-field area could include death from heat, loss of hearing to various degrees, and temporary disruption of life patterns such as feeding, roosting, and moving about. Animals most likely to be affected would include birds (great blue heron, downy and red-bellied woodpecker, mourning dove, housewren), and less mobile terrestrial species such as small mammals (armadillo, weasel, Florida mouse) and herpifauna (snakes, gopher tortoise). Because only two additional launches per year (above the level in the No-Action Alternative) would be anticipated, species sensitive to these disturbances would not likely be adversely affected.

Animal species that stray into the area during a launch could be killed, but the effects to resident populations from this loss would be negligible.

The potential extent of noise impacts would be anticipated to be similar to those described in Section 4.14.1.1.1, Wildlife. Sonic booms created by the launch would occur over the open Atlantic Ocean. The effects of a sonic boom on whales or other open ocean species would be short term and infrequent. The potential for impacts from sonic booms resulting from the use of larger SRMs on Delta IV vehicles is anticipated to be similar to those impacts described in Section 4.14.1.1.1, Wildlife.

An anomaly on the launch pad has been discussed above in Section 4.14.1.1.1.

Essential Fish Habitat and Managed Marine Species. Debris from failed launches has the potential to adversely affect managed fish species and their habitats in the vicinity of the project area as discussed in Section 4.14.1.1.1, Atlas V System. Consultation with the NMFS has been initiated and a technical report on EFH assessment is being prepared. A copy of the correspondence initiating the consultation with NMFS is in Appendix P.

Threatened and Endangered Species. Use of larger SRMs on Delta IV vehicles could potentially affect species protected under the federal Endangered Species Act. Any proposed action would require compliance with the Endangered Species Act of 1973 (16 U.S.C. Sections 1531-1547, *et al.*) if a federal agency determines that there may be a potential impact to individuals, populations, or habitat of any species listed under the Endangered Species Act. Section 7.0 of this act requires the proponent federal agency to conduct endangered species consultation prior to irreversible and irretrievable commitment of resources for all federal actions that pose endangered species concerns. Formal consultation is a process between the USFWS and the proponent federal agency that concludes with the USFWS's issuance of an opinion stating whether or not the action is likely to jeopardize the continued existence of a listed species of interest.

As stated above, no external facility alterations at CCAFS that would significantly affect listed species are proposed as part of implementation of the Proposed Action Delta IV system. During a site visit in June 1999, ospreys were observed nesting on poles located on the lawn between the SRS and RIS buildings. The proposed installation of new paved access driveways and a possible truck loading/unloading facility (total area approximately 0.1 acre) at the SRS and RIS facilities would be expected to result in only minor and temporary disturbance to nearby osprey nests during construction. No displacement of osprey nests or nesting habitat would occur, although disruption should be avoided during the winter nesting season. Although ospreys are not on the federal or state list of threatened or endangered species, they are protected under the federal Migratory Bird Treaty Act (MBTA). Impacts to threatened and endangered species, if any, could occur only from launch activities associated with the two additional launches per year (above the level of the No-Action Alternative) and increased acid deposition. There would be no expected impacts to Florida Scrub Jays, other protected birds (e.g., ospreys, bald eagles), manatees, sea turtles, and marine mammals from these incremental changes to the No-Action Alternative. The potential for impacts to listed species is further discussed below under Sensitive Habitats.

Sensitive Habitats. As stated above, no physical disruption to wetlands or other sensitive habitats at CCAFS would be anticipated as part of the Proposed Action. Potential impacts

from two additional launches per year and the increase in acid deposition caused by use of larger SRMs would not be expected to affect sensitive habitats.

The Banana River, which is west of SLC-37, is manatee critical habitat, but monitoring of manatee habitat conducted for the space shuttle program, which is located on KSC at a similar distance to manatee habitat as SLC-37, has revealed no lasting effect in these waters after a launch has taken place (Schmalzer, et al., 1998). Therefore, the proposed Delta IV vehicles using larger SRMs are not expected to adversely affect manatee habitat. Effects to rookeries in the waters surrounding SLC-37 from launch overflight are discussed in the section on Wildlife.

Effects of noise and sonic booms resulting from the use of larger SRMs on Delta IV vehicles would be as described for wildlife (with the addition of potential impacts in the newly designated critical habitat for the northern right whale [see Section 3.14.1]). The habitat extends from the shoreline out approximately 5 nautical miles and includes waters averaging approximately 30 meters deep.

Sonic booms from Delta IV vehicles using larger SRMs would be expected to occur over this habitat, but as discussed in the Atlas V discussion on Sensitive Habitats, Section 4.14.1.1.1, noise levels from the Proposed Action sonic booms would be far below the level thought to cause harm to marine mammals.

An anomaly on the launch pad was described in the Atlas V discussion, Section 4.14.1.1.1. Manatees, sea turtles, and other aquatic species would not be expected to be adversely affected by an anomaly.

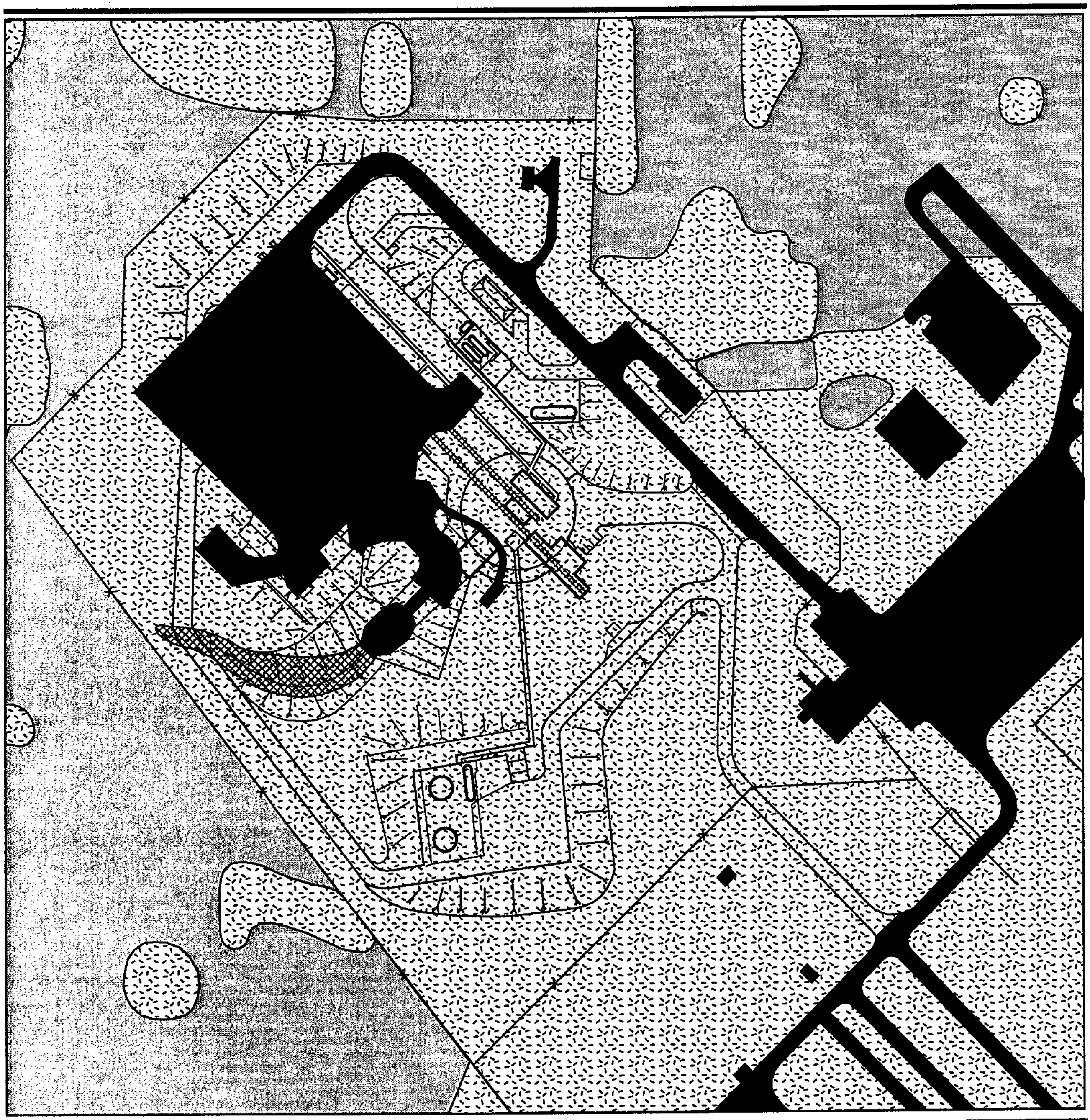
No change to the light management plan that was developed for the No-Action Alternative would be anticipated for the Proposed Action.

4.14.1.2 Vandenberg AFB

4.14.1.2.1 Atlas V System

At Vandenberg AFB, potential impacts to biological resources from the use of SRM-augmented Atlas V vehicles could result from activities at SLC-3W. Monitoring data from previous SRM-assisted launches indicate, however, that impacts would be minimal. No physical alterations of wetlands or critical habitat are anticipated for the Proposed Action. Figure 4.14-3 shows the locations of vegetation and sensitive habitat associated with SLC-3W.

Vegetation. Impacts to vegetation resulting from the addition of SRMs to Atlas V vehicles at Vandenberg AFB would be minimal. Launch effects on vegetation at SLC-3W would be similar to those described for SLC-41 at CCAFS, under Vegetation in Section 4.14.1.1.1. Based on field surveys performed at Vandenberg AFB, vegetation surrounding SLC-3W includes coastal sage scrub, grassland and disturbed areas, mixed grassland-coastal sage scrub, riparian woodland and associated emergent vegetation, Burton Mesa chaparral (central maritime chaparral), and non-native woodland (see Figure 4.14-3). SRMs were used at SLC-3W in the mid- to late-1960s, and it could be expected that some recolonization of the area with more sensitive vegetation has occurred since then. Therefore, vegetation communities immediately surrounding SLC-3W would at first adjust to these new



EXPLANATION

Coastal Sage Scrub

Developed

Electrical line

Grasslands

Wetland (Willow Riparian)

0 60 120 240 Feet

Source: Bionetics Corporation, 1988; site visit, 1997.

SLC-3W Vegetation and Sensitive Habitat Vandenberg AFB, California

Figure 4.14-3

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conditions (e.g., renewed use of SRMs) by the elimination of re-introduced species most sensitive to acidic deposition (Schmalzer, et al., 1998).

Potential effects of acid deposition on the vegetation would be similar to those described for SLC-41 at CCAFS, Section 4.14.1.1.1, and would be limited to foliar spotting occurring between 30 and 800 meters from the launch pad, based on monitoring at CCAFS and Vandenberg AFB. These effects have been shown to be temporary and have not been of sufficient intensity to cause long-term damage to vegetation. Effects are confined to near-field deposition, with no significant impacts occurring from far-field deposition. As a result, after an initial community transition has occurred, launch-induced effects would be temporary, based on monitoring.

Monitoring of acid deposition effects of a Delta II launch in November 1995 at Vandenberg AFB showed no observable signs of acid deposition on vegetation. Delta II HCl emissions are approximately half as great as the Atlas V portion of the Proposed Action; nonetheless, Atlas V emissions are five times lower the Space Shuttle's (Table 4.11-3). Because most of the CCAFS data were collected during Space Shuttle launches, the effects on Vandenberg AFB vegetation from the Atlas V launches are expected to be less severe. Damage to plants (if detectable) would be minor (restricted to near-field deposition) and temporary. Plants generally produce new leaves as a continuous process during the growth season, and replacement of individual leaves can occur several times over a growing season. The growing season in southern California typically occurs through most of the year. Under the Proposed Action, vehicles would be launched from 1 to 5 times per year, allowing sufficient time for plant parts to regenerate themselves between launches.

REEDM, discussed in Appendix R, was used to predict gravitational deposition resulting from the use of SRMs on Atlas V vehicles. Peak HCl deposition occurring under light rain conditions (the acid cloud is rapidly dispersed under dry conditions and no acid deposition occurs) for vehicles with five SRMs was predicted to be approximately 8,100 milligrams per square meter (mg/m^2) at 1,000 meters from the launch pad, and decreasing with distance thereafter. Although these levels of deposition are above ambient conditions, significant impacts are not expected to occur because the conditions under which these impacts would occur (i.e., rain events) are infrequent. Launches during rainfall are relatively rare because of launch criteria developed to protect against lightning strikes.

In addition, monitoring reports frequently noted that the field scientists observed that the acidic and particulate deposition was not of sufficient intensity to cause long-term damage to vegetation. Also, less than significant impacts were confined to near-field deposition. Community-level changes occurring from far-field deposition were not detected (Schmalzer, et al., 1998). It is anticipated that impacts to vegetation from the Proposed Action would be similarly limited.

As with the No-Action Alternative, launch effects on vegetation could also include burning of areas adjacent to the flame trenches and defoliation from heat. Near-field deposition of debris from launches could also damage vegetation. Areas affected by water used for launch activity at the launch pad and vapor cloud could suffer damage from the hot water, but are not expected to experience changes that would affect the composition of the vegetation community. An anomaly on the launch pad could produce extreme heat and fire that would present potential impacts to vegetation. Vandenberg AFB has a high hazard risk

for wildfire that could result from an anomaly, but the periodic occurrence of wildfires implies that the vegetative community at Vandenberg AFB has adapted over the years to fires of natural origin (lightning, etc.). In ecosystems where fire is a natural occurrence, species have developed growth mechanisms to ensure rapid recovery after fires. Recovery from fire damage as a result of the Proposed Action is likely to be rapid, such as within the growing season.

Wildlife. This section summarizes projected impacts to wildlife at Vandenberg AFB resulting from the use of SRMs on Atlas V vehicles under Proposed Action conditions, and is supplemented by the section on threatened and endangered species, below.

As with the No-Action Alternative, the most significant wildlife impacts could occur during the launch activities. Sonic boom studies and noise monitoring have been conducted for the species on Vandenberg AFB and the Channel Islands as part of ongoing monitoring required by USFWS and NMFS (SRS, 1998a, 1998b, 1999a, and 1999b). Monitoring has been conducted to monitor noise levels and observe behavioral response of Pacific harbor seals, California sea lions, northern elephant seals, northern fur seals, Stellar sea lions, Southern sea otters, and snowy plovers. In general, the research has found minimal impact to the species monitored. The impact is generally limited to the pinnipeds eliciting a startle response, progressing toward the water, and returning to the beach no longer than about one and a half hours after the first response. In all cases, pup abandonment, trampling, or extended behavioral effects (such as an interruption in foraging) have not been observed. Launch noise at levels as low as 80 dBA caused a short-term (30-minute) abandonment of a pinniped haul-out area at Vandenberg AFB (Tetra Tech, 1997b). The Proposed Action Atlas V launches would create noise levels lower than 78 dBA at Purisima Point, but would create launch noise of 81 dBA at Rocky Point. These values are lower by 2 to 3 dBA than noise levels generated by the No-Action Alternative's largest vehicle. Because short-term haul-out-area abandonment has not caused noticeable impacts on the pinniped populations at these locations, effects from SRM-augmented launches at SLC-3W would be temporary and minor, and would not be expected to negatively affect these populations. The two pinniped haul-out areas along Vandenberg AFB's coast (Purisima Point and Rocky Point) are shown in Figure 3.14-4 of the 1998 FEIS.

The sonic boom footprint of Atlas V vehicles using SRMs could affect the Channel Islands with up to 7.2 psf, according to model results (Section 4.12). For comparison, the San Miguel and Santa Rosa Islands experienced up to 10 psf during a recent Titan IV launch. Titan IVB vehicles launched from SLC-4E created focused sonic booms over the northern Channel Islands, but showed a lack of significant impact to biota of San Miguel Island (Versar, 1991). Because launch trajectories vary the sonic boom could occur over San Miguel or Santa Rosa Islands, or could miss the Channel Islands completely.

Launch noise effects on cetaceans appear to be somewhat attenuated by the air/water interface (SRS, Technologies 1998). The cetacean fauna in the area have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc., 1997b).

Current launches from Vandenberg AFB require a take permit from the NMFS in order to address the harassment of marine mammals under the Marine Mammal Protection Act. Vandenberg AFB has prepared a 5-year draft programmatic take permit (June 1997)

consolidating different launch programs that would allow incidental harassment of marine mammals to occur during their associated launches. The take permit final rule became effective the day it was published (March 1, 1999) and would be in force until December 31, 2003. The Air Force will request a modification of this permit from NMFS to cover the Proposed Action.

Vehicle noise effects would be less than the heavy-lift variant addressed in the No-Action Alternative. Studies summarized in the Final Programmatic EA for the Marine Mammal Take Permit (Tetra Tech, Inc., 1997b)), as well as more recent noise monitoring studies (SRS Technologies, 1998, 1999), did not report any injury or pup abandonment occurring at any noise level or sonic boom overpressures observed from any launch site. Temporary abandonment of haul-out places was of a longer duration for those areas subject to higher noise levels (Tetra Tech, Inc., 1997b).

An anomaly on the launch pad could produce extreme heat and fire, and flying debris, that could damage adjacent vegetation. Modeling of debris deposition resulting from a launch anomaly (Section 4.13) suggests that vehicle parts would be distributed over an area approximately 1 mile long and would affect an area of approximately 1 square mile if the vehicle destruct occur at T+30 seconds. This situation would spread out the material over a relatively large area that includes Bear Creek. Bear Creek presents optimal riparian habitat for numerous species that could be killed by fire. Habitat fires could drive mountain lions known to occur near SLC-3W to a less optimal habitat, although they would return with habitat regrowth. Vehicle explosion at greater distances would further distribute the material. If the vehicle destruct occurs at T+90 seconds, the material would be scattered over an area approximately 10 miles long located mostly along the coastline between Sudden Flats and Point Conception. It is anticipated that wildlife that occur in that area, including marine birds and harbor seal haul-out areas would be affected. Based on the large volume of sea water and circulation-driven dilution of hazardous substances, it would be unlikely that impacts to wildlife located within the Santa Barbara Channel would occur. If a vehicle destruct were to occur at T+110 seconds, the debris would be scattered for the most part within the Santa Barbara Channel, but some debris could reach the Channel Islands and potentially could affect marine birds and sea mammals, including some listed species (such as the brown pelican).

It is estimated that the chances of an anomaly would be in the range of 2 percent per launch. Additionally, a Health and Safety Plan (see Section 4.7) is in place that would lead to a rapid emergency response to any onsite fire. An anomaly on the launch pad could present potential impacts to wildlife from fire and from the percussive effect of the explosion and falling debris. The Santa Ynez River and Bear Creek are optimal riparian habitat for numerous species that could be killed by a fire. Debris from a downrange anomaly could land in the open ocean, the channel, or on the Channel Islands.

Essential Fish Habitat and Managed Marine Species. Debris from launch failures has the potential to adversely affect managed fish species and their habitats in the vicinity of the project area. Ammonium perchlorate in SRM fuel used in the Proposed Action contains chemicals that, in high concentrations, have the potential to result in adverse impacts to the marine environment. There are 206 fish species that inhabit the waters in the vicinity of the project area that are currently managed by regional fishery management councils. These species and their habitats are required to be addressed regarding potential adverse effects

from the Proposed Action in this SEIS. Consultation with the NMFS has been initiated and a technical report on EFH assessment is being prepared. A copy of the correspondence initiating the consultation with NMFS is in Appendix P.

Threatened and Endangered Species. As stated above, no external facility alterations at Vandenberg AFB are proposed as part of implementation of the Atlas V portion of the Proposed Action. As a result, impacts to threatened and endangered species, if any, would occur only from launch activities. Observations of conditions (Schmalzer, et al., 1998) at the launch facilities have provided evidence that the extent of impact from launches similar to those proposed in this SEIS would be minimal to listed species at and near the launch site.

Southwestern willow flycatchers have been known to nest along the Santa Ynez River. A nesting pair is known to occur near the 13th Street Bridge as it crosses the Santa Ynez River. Monitoring is required under the Titan IV program. Because no Titan IV launches have occurred, however, monitoring has not been conducted. Based on the distance of SLC-3 from the Santa Ynez River, noise modeling predicts that disturbance would not occur.

Based on experience, least terns would not be affected by activity at SLC-3W. Least terns at the Purisima site showed a lack of observable impact from a Titan IV launch from SLC-4 in May 1996 (Read, 1996a). Snowy plovers flushed at launch, but returned to normal behavior soon after (Read, 1996a,b). Atlas V vehicles using SRMs would have less impact on these birds than Titan because the launch site is farther from the coastline, and Atlas V SRMs are significantly smaller.

Because specific monitoring requirements for existing programs have not necessitated extensive data collection at SLC-3W, an examination of data collected at other sites has been used for comparison of potential impacts. The least tern nesting colony near SLC-2 experienced noticeable impacts from Delta II launches in 1997 when numerous launches occurred during the nesting season, although the take remained within the limits of the BO (Johnston, 1998; Read, 1997). The Proposed Action does not include launches from SLC-2 and would, therefore, have less impact to this nesting area. Atlas V launches from SLC-3W would directly overfly snowy plover habitat. Although a startle response from snowy plover would be likely, their reproductive success to date does not appear to be affected by launches, even in the SLC-2 area where Delta II launches were occurring within 0.5 mile of nesting snowy plovers.

Peregrine falcons nest within areas that could be subjected to high noise levels from launch activities. This exposure could cause lower nesting success of peregrines if launches were to occur during the nesting season, as supported by studies outlined in Appendix F in the 1998 FEIS.

Launch noise could disrupt the feeding and roosting activities of brown pelicans, pigeon guillemont, rhinoceros auklet, pelagic cormorant, Brant's cormorant and western gull by causing a startle effect. Additionally, fledgling cliff-nesting species could be startled to bolt from the nest prior to being fully fledged, resulting in fledgling mortality. Potential impacts from launch noise to the unarmored threespine stickleback and the tidewater goby would be minimal because noise is readily and well attenuated by water. Launch noise could potentially startle the red-legged frog, but the effect is expected to be temporary based on monitoring that had occurred for other launch programs at Vandenberg AFB (Christopher

1999a, 1999b). Acid deposition associated with SRM launches is not anticipated to affect the aquatic habitats because of the buffering capacity of surface waters at Vandenberg AFB (see Section 4.9, Water Resources and Appendix R).

The southern sea otter is found off the coast of Vandenberg AFB in a small breeding colony off Purisma Point. Larger populations are found primarily to the north of the base with an increase in sightings of sea otters along Vandenberg AFB's north shore. Observations made by the CDFG and U.S. Geologic Society (USGS) Biological Resource Division have demonstrated increased numbers of sea otters along the north and south shores of Vandenberg AFB (N. Read, pers. Comm.), potentially indicating that the sea otters are not affected by the launches to date. Launches from SLC-3W are not anticipated to result in adverse effects to the sea otter.

Monitoring of both red-legged frog behavior and water quality analysis pre- and post-launch, other launch program BOs, demonstrate that the frogs are not adversely affected by the launches (Christopher, 1999a, 1999b). During a May 1999 Athena launch, counts of individual frogs were performed pre- and post-launch to determine a possible increase in mortality or avoidance of the area due to launch effects. Water quality was monitored pre- and post-launch, and frog mortality attributable to water quality changes was analyzed during an August 1999 Taurus launch. Both monitoring events concluded that the "frogs did not appear to be affected by launch noise or exhaust deposition."

Impacts of an anomaly would be as described in the Wildlife discussion. In addition, the endangered beach layia (plant) is 1.3 miles west and could be affected by a fire. Beach layia protection will be considered in appropriate fire contingency plans.

Sensitive Habitats. As stated above, no physical disruption to wetlands or other sensitive habitats at Vandenberg AFB is anticipated as part of the Atlas V Proposed Action, but potential impacts from launch-related activities have been considered.

The Channel Islands are considered to be a sensitive habitat and have been addressed under the section covering Wildlife. Vandenberg AFB is a significant shorebird migration/wintering area, and these birds are disturbed by launches from South Vandenberg AFB to as far north as Purisima Point, but launches currently take place from SLC-2, located about 1.5 miles from Purisima Point, and the shorebirds continue to use the area.

SLC-3W is close to known major overwintering monarch butterfly sites in Spring Canyon. It is 1.25 miles south of and downwind of the launch site, just south of SLC-4. Hazardous byproducts from launches using SRMs that emit HCl could affect visiting monarch butterflies when the butterflies are congregating (November through February), or could affect their habitat at other times. Offshore, onshore, or southerly winds during the launch could blow the acid cloud away from the butterfly trees; northerly winds could blow the cloud directly over the trees. REEDM modeling indicates that potentially significant amounts of HCl would be deposited within 1,000 meters (0.6 mile) downwind of the overwintering site. Because Spring Canyon is located twice the distance that SLC-3 is located from the butterfly overwintering site, no impact to the butterfly habitat would be expected.

REEDM, discussed in Appendix R, was used to predict gravitational deposition resulting from the use of SRMs on Atlas V vehicles. Peak HCl deposition for vehicles with five SRMs (under light rain conditions) was predicted to be near 8,100 milligrams per square meter at 1,000 meters from the launch pad and decreasing with distance thereafter. Because Spring Canyon is located 1.25 miles (or 2,000 meters) south of the site, acid deposition could occur only if an Atlas launch would occur under rainy conditions with northerly winds; therefore, the probability of impact to the butterfly habitat would be negligible. No impact to the butterfly habitat would be expected, as described under Vegetation.

Bear Creek, the stream located closest to the proposed Atlas V launch pad (SLC-3), could be affected by HCl deposition resulting from a launch. Water quality monitoring conducted by the Air Force showed that Bear Creek has alkalinities upward of 250 mg/L, which is theoretically twice the alkalinity required to neutralize acid deposited by an Atlas V launch; therefore, potential effects to the Bear Creek aquatic habitat and biota are expected to be significant because of the acid-neutralizing capacity of surface waters as described under Water Quality.

White-tailed kite foraging habitat is over the grasslands and coastal sage scrub in the area. Although launches could be disruptive to foraging activities, the launches would be expected to cause only a temporary startle effect and would not negatively affect the kite population.

Impacts to seabird nesting and roosting areas are discussed under the preceding Threatened and Endangered Species section.

Impacts from an anomaly would be as described under Vegetation and Wildlife. Burton Mesa Chaparral, a state-sensitive plant community 2 miles inland, supports sensitive bird species, including Bell's sage sparrow and Southern California rufous crowned sparrow. These species could be adversely affected by a wildfire at Vandenberg AFB caused by an anomaly. Burning of the butterfly trees would make them unsuitable for the overwintering monarchs. Burning of nesting habitat along Bear Creek may lower the reproductive success of the species that use this habitat. Impacts of fire caused by an anomaly would be minimized through the existing fire emergency response procedures established through Vandenberg AFB Fire Regulation 92-1. Brush management in the areas around SLC-3W would keep the heat of the fire lower to help preserve root systems and to facilitate habitat recovery after a fire.

Existing resource agency regulatory requirements mandate that the acoustical environment would be measured during launch of a new vehicle that has not been previously measured. Monitoring and survey activities are ongoing. Multiple launches potentially could result in a particularly sensitive species abandoning the area or having low breeding success. Monitoring could help identify these effects, should they occur.

All launch effects on marine mammals would be monitored according to the monitoring measures included in the NMFS take permit, issued in March 1999. A BO for Titan IVB launches from SLC-4 requires monitoring of sample populations of western snowy plovers, California least terns, peregrine falcons, and southwestern willow flycatchers before, during, and after launches during the breeding season, and monitoring of sample populations of wintering western snowy plovers during the non-breeding season. No

impacts to their continued use of habitat areas or nesting success of wintering and nesting snowy plovers has been observed, although they may flush at the sight and sound of a launch. Impacts to snowy plover from SLC-3W launches have not been studied, and SLC-3W launches would result in more direct overflight of snowy plover habitat than launches from SLC-4. On this basis, monitoring of snowy plovers is warranted (Read, 1997). Pre-launch helicopter security patrols cause the most disruption to snowy plover behavior; every effort should be made to ensure that these patrols do not unduly disturb this species (Read, 1996a). This effort would be accomplished through coordination with Environmental Management at Vandenberg AFB to appraise the security overflight personnel of the areas sensitive to direct overflight.

Least terns at the Purisima site also show a lack of observable impact from Titan IVB SLC-4 launches. Monitoring of these least terns is likely to be required because there are no data from launch effects on least terns from SLC-3W launches. If least terns re-establish a nesting site near the Santa Ynez River, terns at this location could be monitored for launch-related effects.

Pre- and post-launch monitoring of peregrine falcons could be conducted during the incubation and fledgling periods to note any breakage of thin eggshells caused by historical deposition of DDT in the region from other industrial activities. Environmental Management would identify nest sites and nesting phases of concern during each year, as identified through their ongoing sensitive species status monitoring program.

4.14.1.2.2 Delta IV System

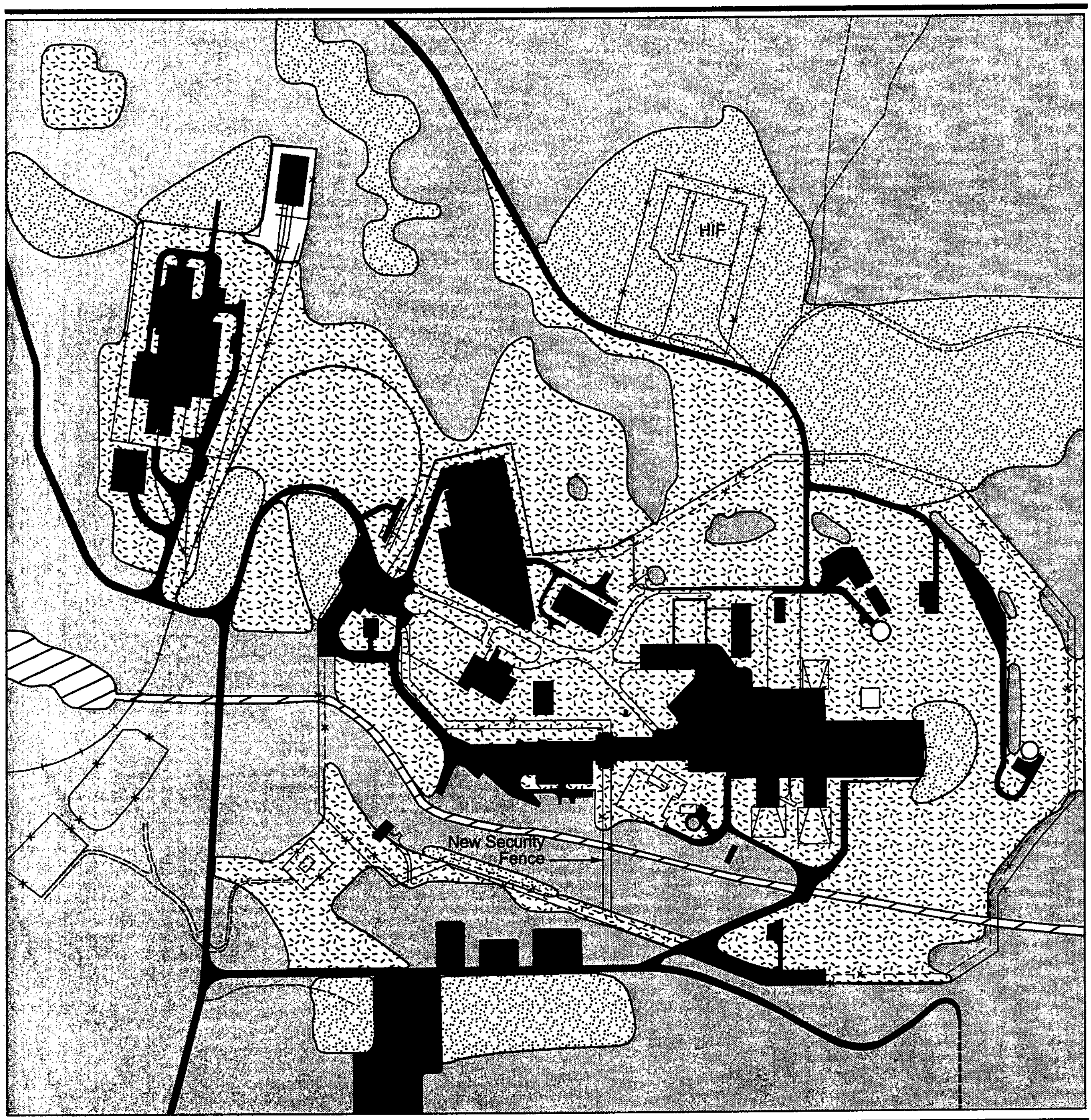
At Vandenberg AFB, potential impacts to biological resources resulting from the use of larger SRMs on Delta IV vehicles would occur from launch-related activities at SLC-6. No physical alteration of wetlands or other critical habitat would be anticipated for the Delta IV portion of the Proposed Action at Vandenberg AFB. Figure 4.14-4 shows the locations of vegetation and sensitive habitats associated with SLC-6.

Vegetation. Vegetation disturbance would be minimal for the Delta IV program. Vegetation would be affected by the direct effect of the launches (i.e., burning, defoliation, near-field deposition).

Effects to vegetation from launches, acid cloud deposition, and launch anomalies would be minimal, and would be similar as those summarized in Sections 4.14.1.1.1 and 4.14.1.2.1, Vegetation.

REEDM, discussed in Appendix R, was used to predict gravitational deposition resulting from the use of larger SRMs on Delta IV vehicles. Peak HCl deposition for SRM-assisted Delta IV launches, occurring under light rain conditions, was predicted to be approximately 5,434 mg/m^2 at approximately 4,000 meters from the launch pad and falling off thereafter. Vegetation monitoring data that has occurred for a November 1995 Delta II launch at Vandenberg AFB did not show any observable damage to vegetation. Because the Proposed Action Delta IV HCl emission rate is slightly lower than the Delta II HCl emission rate, no measurable effects on vegetation are expected under the Proposed Action CCAFS.

Wildlife. The primary effects to wildlife could occur during the launch activities at Vandenberg AFB. Impacts to marine species and general wildlife from pre-launch control



EXPLANATION

Double Fence (If required)		Barren	
Security Fence		Coastal Sage Scrub	
HIF	Horizontal Integration Facility	Grassland	
Developed		Wetland	

0 145 290 580 Feet

Source: Bionetics Corporation, 1988; site visit, 1997.

SLC-6 Vegetation and Sensitive Habitat Vandenberg AFB, California

Figure 4.14-4

EEL/110

aircraft overflights and the direct effect of launches would be similar to those described in Section 4.14.1.2.1, Wildlife.

Physiological and behavioral response to sonic booms and launch noise on pinnipeds and birds of California would be similar to those described in Section 4.14.1.1.2. General impacts to snowy plover are described in Section 4.14.1.2.1.

SRM exhaust forms a HCl cloud during launch. The emissions caused by SRMs potentially could affect the shallow Cañada Honda Creek where the tidewater goby, the unarmored threespine stickleback, and the red-legged frog are found. Extensive monitoring of expendable launch vehicles on the East Coast (CCAFS) has revealed that the HCl cloud of launch vehicles larger than or similar to the Proposed Action vehicles is typically confined to an area within 0.5 mile of the launch pad and does not affect the pH of nearby surface waters on a long-term basis. Cañada Honda Creek water quality was monitored for pH, dissolved oxygen, nitrate nitrogen, and salinity during a recent launch from SLC-6 (Christopher 1999a). The results did not show any launch effect on any of the measured water quality parameters. It is also anticipated that the ambient buffering conditions associated with the proximity of the ocean saltwater would effectively protect the existing aquatic habitats from acidification (as described in Section 4.9 Water Quality).

An anomaly would cause negative effects, as described in Section 4.13. The chances of an anomaly, and the emergency response to such an event, have been discussed in Section 4.14.1.2.1. Modeling of debris deposition resulting from a launch anomaly suggests that vehicle parts would fan out over an area approximately 2 miles long and 1 mile wide if the vehicle destruct occurred at T+30 seconds, spreading out the material over a relatively large area that includes the grasslands of the Sudden Flats, a breeding ground for the California horned larks, and beaches located east of the South Vandenberg boat dock. Vehicle explosion at greater distances would be similar to discussion provided in Section 4.14.1.2.1.

Essential Fish Habitat and Managed Marine Species. Debris from launch failures has the potential to adversely affect managed fish species and their habitats in the vicinity of the project area as discussed in Section 4.14.1.1.1. There are 206 fish species that inhabit the waters in the vicinity of the project area that are currently managed by regional fishery management councils. These species and their habitats are required to be addressed regarding potential adverse effects from the Proposed Action in this SEIS. Consultation with the NMFS has been initiated and a technical report on EFH is being prepared to address this issue. A copy of the correspondence initiating the consultation with NMFS is in Appendix P.

Threatened and Endangered Species. Impacts to threatened and endangered species at Vandenberg AFB would be similar to those described in Section 4.14.1.2.1.

Effects of SLC-6 launches on willow flycatchers along the Santa Ynez River would be minimal (see Section 4.14.1.2.1).

Monitoring on snowy plovers indicates either a lack of observable impact or flushing behavior followed by a return to previous behavior soon after observation (Read 1996 a, b). Monitoring of least terns at Purisma Point indicates an observable impact from Delta launches conducted at SLC-2; primarily chick and nest abandonment (Read, 1999). SLC-6 is

located approximately 12 miles from the Purisima Point least tern habitat. Because this locale is about 8 times further than SLC-2, sound exposure levels are expected to be at least 15 dB (A-weighted) lower (see Figure 4.12-8), and the noise impact to least terns would be significantly attenuated.

General impacts to peregrine falcons from launch activities are described in Section 4.14.1.2.1. Because SLC-6 is much closer to the peregrine's nesting area than SLC-4, the potential for impacts from Delta IV vehicles using larger SRMs could be greater than for Titan IVB from SLC-4. Two recent LMC vehicle launches from SLC-6 were monitored and no substantial effects to peregrine falcons were noted, although these launches did not occur during the nesting season. Launching during the nesting season could adversely affect peregrine falcon nesting success because of this species' vulnerability to disturbance during this time.

Potential general impacts from launch noises to the unarmored threespine stickleback and the tidewater goby are described in Section 4.14.1.2.1.

The acidic emissions caused by solid rocket motors could affect the shallow Cañada Honda Creek, but only if the wind is atypical (i.e., from the south). The tidewater goby, the unarmored threespine stickleback, and the red-legged frog inhabit the creek and could be adversely affected by acidification of the water. These impacts would be similar to those experienced under the current launch programs. Recent monitoring of a LMC vehicle launch from SLC-6 did not show a substantial effect on the red-legged frog found in the water treatment ponds near the launch pad (Christopher, 1999a). Extensive monitoring of launches on the East Coast has revealed that the HCl cloud of vehicles similar to the Delta IV vehicle is typically confined to an area within 0.5 mile of the launch pad and does not affect the hydrogen ion concentration (pH) in nearby surface waters. Furthermore, HCl deposition associated with SRM use would not likely affect the aquatic habitats because of the buffering capacity of surface waters at Vandenberg AFB, as described in Section 4.9.

Impacts from an anomaly would be as described under Wildlife. Sensitive species residing in the surrounding cliffs could be injured or killed from the explosion, but the chance is extremely low.

Sensitive Habitats. The Channel Islands are a sensitive habitat; potential impacts to them have been discussed under Wildlife. Shorebird nesting occurs along the coast of Vandenberg AFB and is disturbed by launches from South Vandenberg AFB to as far north as Purisima Point. However, launching has occurred out of SLC-2 (approximately 1.5 miles from Purisima Point), and the shorebirds continue to use the area; consequently, no long-term adverse impacts from the proposed Delta IV vehicles is expected.

Butterfly trees are present near SLC-6, and the visiting monarch butterflies could be affected by the HCl cloud if an SRM-augmented launch occurs when the butterflies are congregating (November through February). Offshore or southerly wind directions during the launch could blow the HCl cloud away from the butterfly trees; onshore or northerly winds could blow the cloud directly over the trees and result in some acid deposition under rainy conditions.

Impacts from an anomaly would be as described in Section 4.14.1.2.1, Sensitive Habitats. Such anomalies could affect sensitive species and habitat along Cañada Honda Creek and in the cliffs surrounding SLC-6.

Existing resource agency regulatory requirements have been discussed in Section 4.14.1.2.1.

Water quality in Cañada Honda Creek should continue to be monitored to assess the effects from the use of SRMs to sensitive species and habitats, should prevailing winds come from the south.

4.14.1.3 Cumulative Impacts of Proposed Action

The purpose of this section is to describe the cumulative impacts resulting from the Proposed Action for both programs at both locations.

The other major launch program near CCAFS is the Space Shuttle, launched from KSC. Approximately four launches per year are scheduled for the next decade. Shuttle launches result in much higher levels of noise and deposition than the launches will under the Proposed Action. The Proposed Action would result in an average of two additional EELV program launches per year over the No-Action Alternative, which would not increase cumulative impacts significantly.

Other programs at Vandenberg AFB include anticipated launches of Minuteman and Peacekeeper missiles from North Vandenberg AFB, aircraft flight operations, and helicopter operations. These launches have less of an impact than the Proposed Action launches, and are not expected to contribute significantly to any cumulative effect.

The California Commercial Spaceport, Inc., proposed to launch up to 24 payloads per year (over a 4-year period) into polar orbit from Vandenberg AFB. One CSA launch has occurred since publication of the environmental documentation for that action (California Commercial Spaceport, Inc. and Lockheed Systems and Technology Company, 1994). Two launches are tentatively scheduled (one each in 2000 and 2002). No other CSA launches are planned (Personal communication, Ron Cortopassi, Jim Johnston, and Lori Redhair, September 1999). These planned, limited CSA launches are not anticipated to result in a significant contribution to cumulative effects. In addition, the BO for the California Spaceport identifies detailed monitoring requirements and other measures to offset anticipated or potential impacts to plant and wildlife species. A draft report on monitoring activities at the spaceport is to be submitted annually for approval by the appropriate agencies. Specific monitoring is to be conducted for peregrine falcons, noise levels near brown pelican roost sites, and sea otters counts following launches. Water quality and species monitoring will be conducted if predictive modeling indicates impacts from Spaceport launches. These reporting and monitoring activities are expected to result in avoidance of impacts that could be considered cumulatively significant in combination with the Proposed Action in this FSEIS.

Monitoring is also currently conducted for the Atlas, Titan, and Delta vehicle launches at Vandenberg AFB, and similar monitoring may occur for the EELV program, as might be required to support a determination that no taking arises from the launch activities. Specifically, monitoring of western snowy plover, brown pelican, peregrine falcon, and red-legged frog could be conducted at SLC-6. At SLC-3, southwestern willow flycatcher

and red-legged frog could be monitored. Monitoring for effects of launch noise on pinnipeds and shorebirds could continue for haulout areas around SLC-3 and SLC-6. On the basis of this monitoring activity, impacts not originally anticipated during the assessment of environmental impacts conducted for this FSEIS could be identified and addressed in consultation with the USFWS.

Cumulative impacts to harbor seals, California sea lions, and northern elephant seals resulting from the No-Action Alternative have been discussed in a previous EA (U.S. Air Force, 1997 as cited in 63 FR 39055) and by NMFS (63 FR 39055). The cumulative impacts do not differ substantively from impacts associated with the Proposed Action alone, because the Proposed Action would result in an increase of seven launches over 20 years from the launches of the No-Action Alternative.

In summary, it was concluded that each rookery/haulout site along the Vandenberg AFB coastline would be impacted by sufficient noise at each launch to cause harbor seals to leave the rocks fewer than 30 times annually as a result of missile and larger vehicle launches, and associated helicopter safety patrols, and 10 times annually as a result of aircraft operations. On the Northern Channel Islands, pinnipeds could leave the beach when a launch passes over or in the vicinity of a haulout on one of the Islands. Long-term effects, such as stress and migration from chronic exposure to noise are not expected, because all noise events would be transitory and limited in number and duration.

4.14.2 No-Action Alternative

The No-Action Alternative will occur whether or not the Proposed Action is implemented.

4.14.2.1 Cape Canaveral Air Force Station

The No-Action Alternative will result in some construction activities and other actions that could result in minor and transitory impacts to biological resources, as described in the 1998 FEIS.

4.14.2.1.1 Atlas V System

Ground-disturbing activities at SLC-41 will include the assembly facilities sites and road intersection modification. These activities, and launch-related actions, could cause minor impacts to local plant and animal communities and sensitive habitats, as described in the 1998 FEIS. Destruction of road shoulder (mowed grass), wetland scrub, and wetland marsh will require mitigation, but few of these areas are currently unaltered or are already impacted by exotic nuisance vegetation.

Mitigation measures adopted for 1998 FEIS (for wetland impacts at SLC-41) (Smith Environmental Services, 1997) include a 1.5 to 1 restoration for wetlands lost by removing the 1.4-mile dike, and a 7.4 to 1 enhancement of existing wetlands through reconnection of the 54-acre impoundment to the adjacent Banana River. This dike has already failed in one place, and the adjacent perimeter ditch has been filled with the dike spoil material. The dike footprint covers 6.7 acres that will be replaced by marsh. The work is being monitored to minimize effects to manatee and is being coordinated with the FDEP and USFWS. A 3-year biological monitoring program is being conducted to determine whether impoundment restoration goals are being achieved. The removal of the berm will allow the waters to ebb and flow with the tide and will allow an exchange of nutrients and marine species. Cattail

monoculture density is expected to decrease when the wetland water level begins to fluctuate, creating a diverse habitat capable of supporting a greater number of species.

Impacts to wildlife and listed species will be minimal and similar to the Proposed Action, resulting from pre-flight overflights, noise and heat from launches, and sonic booms over the open ocean. No SRMs will be involved in the No-Action Alternative at SLC-41, so acid deposition is not an issue. Monitoring of the Florida scrub jay occurred during Titan IVB launches at SLC-41 and found no ill effects to the jays (Schmalzer, et al., 1998). Lift vehicles proposed under the No-Action Alternative are substantially smaller than the Titan vehicles, so fewer impacts are anticipated. Also, a light management plan to mitigate impacts to sea turtles is being developed for the No-Action Alternative. The plan has been approved by the Air Force and is being prepared for submittal to USFWS. The plan includes standard light mitigation elements including use of low-pressure sodium lamps, limiting hours of usage, and alignment of lights away from the beach.

4.14.2.1.2 Delta IV System

Ground-disturbing activities at SLC-37 (to be completed for either the No-Action Alternative or the Proposed Action) will include work at SLC-37, lightning protection towers at the (HIF) construction site, along new utility corridors, and from dredging activities at the roll-on/roll-off dock. These activities and launch-related actions could result in minor impacts to local plant and animal communities and sensitive habitats, as described in the 1998 FEIS. Clearing of vegetation within the launch perimeter will occur. HCl deposition from use of SRMs will also cause minor impacts to nearby vegetation, especially when combined with post-launch washdown water, as described in the 1998 FEIS.

Impacts to wildlife and listed species will be minor and similar to the Proposed Action, resulting from pre-launch overflights, noise and heat from launches, and sonic booms over the open ocean. The USFWS issued a BO on May 18, 1998, regarding impact to the southeastern beach mouse (federally listed as threatened) as a result of EELV construction and operations at SLC-37. The USFWS determined that the activities in the area would result in an incidental take of the mice, but were not likely to jeopardize the continued existence of the species. The BO provided a nondiscretionary list of reasonable and prudent measures and associated terms and conditions to be implemented as part of the EELV program to minimize take of the species. The measures included implementation of a trap-and-release program to remove the mice from areas of construction and the construction of a flame deflector to minimize impacts to the mice during vehicle launches. Additionally, a light management plan to mitigate impacts to sea turtles is being developed. The plan will include standard light mitigation elements including use of low-pressure sodium lamps, limiting hours of usage, and alignment of lights away from the beach.

4.14.2.2 Vandenberg AFB

4.14.2.2.1 Atlas V System

At Vandenberg AFB, potential impacts to biological resources from the No-Action Alternative could occur from ground-disturbing activities at SLC-3W, at the assembly facilities, power substation, Upper Stage Processing Facility construction sites, at road intersections that will be modified, and from the 14 launches per year at SLC-3W. All other facilities will be used as is, and no biological resources impacts are expected from their use.

Vegetation disturbance will be minimal. Areas that will be disturbed during facility construction are bladed road shoulders, mowed grasses and forbs, and weedy parking areas.

Wildlife will be temporarily displaced during the construction of the assembly buildings and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is present nearby. The greatest potential for wildlife impacts will occur during the launch activities.

Effects from launch noise under the No-Action Alternative at SLC-3W will be temporary and minor, and are not expected to negatively affect the local pinniped populations. Studies conducted before, during, and after Titan IVB launches from SLC-4 resulted in several recommended mitigations for future monitoring of sensitive species that are also considered for the No-Action Alternative launches. These mitigation measures are discussed in Section 4.14.2.2.1. Monitoring of water quality in Cañada Honda Creek will be continued to assess effects to sensitive species and habitats, if SRMs are used and if the prevailing winds are from the south.

Impacts to threatened, endangered, or sensitive species from launches are not expected to jeopardize the existence of any species, including the southwestern willow flycatcher, least terns, snowy plovers, peregrine falcons nests, brown pelicans, unarmored threespine sticklebacks, tidewater gobies, red-legged frogs, and southern sea otters. A willow wetland has been identified on SLC-3W. All affected wetlands are subject to consultations under Section 404 and a Finding on No Practicable Alternative (FONPA) (signed June 1998), as required by EO 11990, was conducted. SLC-3W is close to known major overwintering monarch butterfly sites in Spring Canyon, but no impacts to butterflies are anticipated under the No-Action Alternative.

An anomaly on the launch pad could produce extreme heat and fire that could present potential impacts to vegetation and wildlife. Vandenberg AFB has a high hazard risk for wildfire, which could result from an anomaly, but a Health and Safety Plan (see Section 4.7) is in effect that will allow a rapid emergency response to any hazardous scenario caused by an anomaly.

The Air Force initiated formal consultation under Section 7 of the Endangered Species Act with the USFWS for the EELV program (both Concepts A and B) in a May 29, 1998, letter. The Air Force letter described potential impacts to federally listed species and proposed monitoring for such impacts similar to monitoring programs under way for other launch programs at Vandenberg AFB. The consultation process is continuing and is expected to be supplemented with information from this FSEIS, before the issuance of a BO. A programmatic take permit for the incidental harassment of marine mammals was issued by the NMFS on April 2, 1999. While this permit currently addresses launches and associated monitoring requirements for Atlas, Titan, Delta, and other launch vehicles, it does not specifically address EELV program vehicles. The Air Force, however, anticipates that the permit can be extended to cover the similar EELV program vehicles subsequent to further consultation with the NMFS.

4.14.2.2.2 Delta IV System

At Vandenberg AFB, potential impacts to biological resources from the Delta IV system with SRMs under the No-Action Alternative could occur from ground-disturbing activities at and

adjacent to SLC-6, mainly from the construction of the Horizontal Integration Facility, from dredging and offloading activities at the boathouse dock, and from launch activities at SLC-6. Biological resources impacts are not expected from use of other facilities. Some of the launches will use solid propellants, whose combustion produces an acid cloud at launch.

A fence will be constructed along the wetland drainageway and could affect some native shrubs. Effects to vegetation from launches, acid cloud deposition, and launch anomalies will be the same as those summarized under the proposed Atlas V system with SRMs for Vandenberg AFB (specific vegetation effects) and under the Delta IV system for CCAFS (HCl cloud effects).

Wildlife, including small mammals and birds, will be temporarily displaced during construction and other ground-disturbing activities, but the effect to the wildlife population will be negligible because sufficient suitable habitat is available nearby. The impacts to open-ocean species from direct ocean impacts, and to general wildlife species from pre-launch control aircraft overflights and the direct effects of launches, will be similar to those described under the Proposed Action, Atlas V system with SRMs, for Vandenberg AFB. In addition, general sonic boom studies and specific studies (Tetra Tech) have been conducted for the species on Vandenberg AFB and the Channel Islands, and no long-term adverse effects on these species or their habitats are anticipated from the EELV program launches.

Dredging of the boat dock area and the disposal of 10,000 cubic yards of dredged material at a site approved by the U.S. Army Corps of Engineers (USACE) is not expected to cause significant impacts. The California Coastal Commission, however, currently has this issue under consideration. The acidic emissions caused by SRMs have a potential to affect the shallow Cañada Honda Creek where the tidewater goby, the unarmored threespine stickleback, and the red-legged frog are found. Extensive monitoring of expendable lift vehicles on the East Coast (CCAFS) has revealed that the HCl cloud of the Space Shuttle and Titan IVB vehicles, both larger than any EELV program vehicle, is typically confined to an area within 0.5 mile of the launch pad and produces only short-term changes to the pH of nearby surface waters.

Impacts to threatened and endangered species under the No-Action Alternative will be similar to those described in Section 4.14.1.2.1. Launches from SLC-6 are expected to have less impact on the willow flycatcher and least terns than launches from SLC-3W, because SLC-6 is located farther from their nesting sites. Recent monitoring activities have shown that no substantial effects to peregrine falcons are expected from launches, except during the more sensitive nesting season. Recent monitoring on California red-legged frogs (Christopher 1999a) also has shown no substantial impacts to the frogs at the wastewater ponds adjacent to SLC-6 occurred. The ground and water disturbance associated with the boat dock is not expected to cause permanent abandonment of the area by brown pelicans, nor is it expected to cause long-term crowding in the more favorable roosting sites, given the infrequency and short duration of proposed EELV program No-Action Alternative activities.

The negligible impacts on southern sea otters from South Vandenberg AFB launches are described in Section 4.14.2.2.1. Sea otters could be disturbed during offloading of Delta IV system common booster cores at the boat dock. The infrequent use of the area for EELV

program activities, however, is not expected to result in permanent abandonment of the area by the otters.

Potential general impacts from No-Action Alternative launch noises to the unarmored threespine stickleback and the tidewater goby are described in Section 4.14.2.2.1. The HCl emissions caused by SRMs could affect the tidewater goby, the unarmored threespine stickleback, and the red-legged frog that inhabit Cañada Honda Creek, but only if the wind is atypical (i.e., from the south). Monitoring of launches on the East Coast has revealed that the HCl clouds of other lift vehicles, including the Space Shuttle and Titan IV, both of which are larger than any EELV program vehicle, do not result in a long-term change in the pH in nearby surface waters.

The Channel Islands are a sensitive habitat, and potential impacts to them have been discussed under Wildlife. Butterfly trees are present near SLC-6, and the visiting monarch butterflies could be affected by the HCl cloud if an SRM-assisted launch occurs when the butterflies are congregating (November through February).

4.15 Cultural Resources

This section describes the potential environmental impacts on cultural resources from implementing the Proposed Action and the No-Action Alternative.

4.15.1 Proposed Action

This section describes impacts from the Proposed Action which includes <u>both</u> the Atlas V and Delta IV systems. Potentially significant impacts to cultural resources can result from new ground-disturbing construction that impairs prehistoric or historic archaeological and/or paleontological resources, removal or modification of historically significant buildings and structures, or causes similar impacts that might degrade the integrity of traditional cultural resources.

4.15.1.1 Cape Canaveral Air Force Station

4.15.1.1.1 Atlas V System

The Atlas V portion of the Proposed Action would involve no ground disturbance at CCAFS. Modifications of support facilities, if any, are not anticipated to result in any ground disturbance and would entail only internal building modifications. Project access routes would use existing road infrastructure. As a result, the Atlas V portion of the Proposed Action would have no impact on cultural resources at CCAFS.

4.15.1.1.2 Delta IV System

The Delta IV portion of the Proposed Action at CCAFS involves only minor ground disturbance. To accommodate the transport of SRMs to the RIS (Building 70580) and the SRS (Building 70451), some turns on the existing road would need to be widened. This paving activity would be the only ground disturbance in the Proposed Action and there are no National Register-listed or -eligible prehistoric or historic archaeological sites or archaeologically sensitive areas in the ROI. Although Buildings 70580 and 70451 would be modified to accommodate the larger SRMs, neither building was identified in previous surveys as historically significant. In addition, the Florida Division of Historical Resources

determined that Hangar J is not eligible for National Register listing (see Appendix P). As a result, no effects on archaeological resources would be expected from the construction activities associated with the use of larger SRMs in the EELV program at CCAFS.

Mitigation Measures, CCAFS. Because no National Register-listed or -eligible prehistoric or historic archaeological resources or traditional resources have been identified within the direct ground disturbance ROI of the Delta IV paving activity, no mitigation measures have been identified. However, if cultural materials (particularly human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and the Florida State Historic Preservation Office (SHPO) would be consulted through the CCAFS Environmental Office (1998 FEIS, Appendix I). Subsequent actions would follow guidance provided in Title 36 CFR 800.11 and/or in the Native American Graves Protection and Repatriation Act (NAGPRA).

4.15.1.2 Vandenberg AFB

4.15.1.2.1 Atlas V System

The Atlas V portion of the Proposed Action would involve no ground disturbance at Vandenberg AFB. Modifications of support facilities, if any, are not anticipated to result in any ground-disturbance and would only entail internal building modifications. Project access routes would use existing road infrastructure. As a result, the Atlas V portion of the Proposed Action would have no impact on cultural resources at Vandenberg AFB.

4.15.1.2.2 Delta IV System

In the interim since the DSEIS was released, road and infrastructure modifications are being considered for the Delta IV portion of the Proposed Action at Vandenberg AFB in the vicinity of Building 945. Potential cultural resources impacts associated with these changes will be addressed in a separate NEPA review process. All other modifications of support facilities, if any, are not anticipated to result in any ground-disturbance and would only entail internal building modifications. Project access routes would use existing road infrastructure. As a result, the Delta IV portion of the Proposed Action would have no impact on cultural resources at Vandenberg AFB.

4.15.1.3 Cumulative Impacts

Other than the activities that were previously addressed in the 1998 FEIS, there are no identified program launch or construction activities that would, in combination with the Proposed Action, result in cumulative impacts. As a result, there would be no cumulative impact in combination with other programs.

4.15.2 No-Action Alternative

The No-Action Alternative will occur whether or not the Proposed Action is implemented. For further information on the No-Action Alternative impacts on cultural resources, refer to the 1998 FEIS.

4.15.2.1 Cape Canaveral Air Force Station

Construction associated with the No-Action Alternative at CCAFS will not affect any National Register-listed or -eligible prehistoric or historic archaeological sites, or

archaeologically sensitive areas. The Florida State Historic Preservation Office (SHPO) concurred in letters on May 7, 1999, and March 4, 1999, that the modification of Hangars C and J (both potentially eligible for listing on the National Register of Historic Places) would have no effect on their historic value. In a subsequent letter from the Florida SHPO (see Appendix P), it was determined that Hangar J is not eligible for the National Register. The SHPO also concurred that the other activities proposed under what is now the No-Action Alternative would have no effect on the other sites listed or eligible for listing on the National Register. Mitigations, if required, will be developed in consultation with the Florida SHPO. No traditional cultural resources have been identified in the ROI at CCAFS.

4.15.2.2 Vandenberg AFB

Construction associated with the No-Action Alternative at Vandenberg AFB will not affect any National Register-listed, -eligible, or potentially eligible prehistoric or historic archaeological sites.

As stated in the 1998 FEIS, SLC-3W and its associated support facilities are eligible for listing on the National Register of Historic Places under the Cold Water historic context. On August 13, 1999, the Air Force signed a MOA with the California SHPO (see Appendix P) stipulating that while the construction at SLC-3W under what is now known as the No-Action Alternative was determined to adversely affect the property, this effect has been satisfactorily taken into account through the previous completion of Historic American Building Survey/Historic American Engineering Record(HABS/HAER) recordation for SLC-3. The executed MOA addresses the continuing treatment of historic properties at SLC-3 under the EELV program. The Air Force consulted with the California SHPO under Section 106 of the National Historic Preservation Act regarding potential impacts to historic resources at SLC-6 under Concept B of what is now known as the No-Action Alternative. The SHPO concurred in a June 20, 1999, letter that the potential impacts to a nearby National Register-eligible archaeological site were minimal and would not affect any of the characteristics that make it eligible for inclusion in the National Register. Therefore, the SHPO concurred that Concept B would not adversely affect historic properties.

4.16 Environmental Justice

Activities associated with the Proposed Action would have no adverse effects on low-income and minority populations for the following resource areas analyzed:

- Community setting
- Land use and aesthetics
- Utilities
- Hazardous materials and hazardous waste
- Health and safety
- Geology and soils
- Water resources
- Noise
- Biological resources
- Cultural resources

Air quality impacts would be basinwide, and orbital debris impacts would be on a global scale, so no disproportionately high and adverse air quality impacts or orbital debris impacts would be expected to low-income and minority populations.

Cape Canaveral Air Force Station. Neither the addition of SRMs to the Atlas V system nor to the Delta IV system with larger SRMs would result in any environmental justice impacts at CCAFS. Consequently, no cumulative impacts would result from the Proposed Action.

Vandenberg AFB. Neither the addition of SRMs to the Atlas V system nor to the Delta IV system with larger SRMs would result in any environmental justice impacts at Vandenberg AFB. Therefore, no cumulative impacts would result from the Proposed Action.

5.0 Consultation and Coordination

The federal, state, local, and private agencies/organizations that were contacted during the preparation of this Supplemental Environmental Impact Statement are listed below.

Federal Agencies

Cape Canaveral Air Force Station, Environmental Flight
Headquarters Air Force Space Command
National Marine Fisheries Service
Vandenberg Air Force Base, Environmental Flight

State Agencies

(none contacted)

Local/Regional Agencies

Brevard County Land Development Group, FL
City of Cape Canaveral Building Department, FL
City of Lompoc Planning Department, CA
City of Lompoc Regional Wastewater Treatment Plant
County of Santa Barbara, CA, Solid Waste Program
Santa Barbara County Planning and Development Department, CA

Private Agencies and Organizations

Aerospace Corporation
McDonnell Douglas Corporation, a wholly owned subsidiary of the Boeing Company
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8.0 Index

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9.0 Public Comments and Responses

9.1 Introduction

In accordance with NEPA, the Air Force made the 1999 DSEIS available for public comment and conducted public hearings to receive comments on the document. Notice of the availability of the DSEIS for public review was published in the *Federal Register* on November 12, 1999, and this notification initiated the 45-day comment period. The comment period closed on December 27, 1999.

Public hearings were held at Cape Canaveral, Florida, on December 7, 1999, and at Lompoc, California, on December 9, 1999. At these hearings, the Air Force presented the findings of the DSEIS.

Nine comment letters totaling approximately 70 individual comments were received from agencies, organizations and individuals during the public comment period. Three individuals presented oral testimony at the hearing in Lompoc and two people presented oral testimony at Cape Canaveral. At the Lompoc hearing on December 9, 1999, two of the three speakers also submitted written comments.

On the basis of comments received on the DSEIS, several revisions and updates have been incorporated into the FSEIS to clarify issues and assumptions used in the analyses. These revisions are noted in the comment responses, where appropriate, and in the applicable sections of the FSEIS. In general, changes to the following topics were made:

- Background water quality data were revised to incorporate clarification of assumptions about the duration, velocity, and wind direction of rain events for use in assessing HCl impacts of the Proposed Action. The updated methodology and findings are in Appendix R.
- Additional REEDM modeling was conducted to assess air quality impacts. Revisions were made to the vehicle database and the handling of aluminum oxide particulates. As a result of the revisions, PM_{10} emissions are within 24-hour California Ambient Air Quality Standard.
- Appendix T has been updated to incorporate the additional information and Section 4.10 of the FSEIS has been revised to incorporate the updated model results.
- The Air Force initiated formal consultation with NMFS on potential impacts of the Proposed Action on EFH. An EFH technical report is being prepared to assess impacts to marine fisheries resources. Preliminary results support the determination that the proposed action will result in no more than minimal adverse effects to EFH both individually and cumulatively. The consultation process is planned for completion before the ROD is signed. Appendix P contains copies of the letters that initiated consultation.

- Additional biological resources monitoring data for Vandenberg AFB were incorporated into Section 4.14, including recent monitoring for water quality, threatened and endangered species, and noise. In all cases, the monitoring did not show adverse effects to the resources monitored.
- Additional information on the procedures used for assessing the management of public health and safety was added to Section 3.7.1, and is also summarized in General Comment Response No. 1.
- The total volume of water use for Delta IV launches at Vandenberg AFB was increased from 60,000 gallons to 185,000 gallons. The water use originally estimated in the 1998 FEIS was preliminarily based on similar vehicle design. More definitive vehicle design data now indicate a maximum usage of 185,000 gallons per launch. This increase does not result in an adverse impact on water supply or utilities (see Sections 4.5 and 4.9 of the FSEIS).

The following individuals, agencies, and organizations submitted comments on the DSEIS. The comment letters presented in this chapter are numbered as follows:

1. U.S. Environmental Protection Agency
2. National Marine Fisheries Service, Southeast Regional Office
3. Santa Barbara County Air Pollution Control District
4. City of Lompoc, California
5. Thiokol Propulsion
6. Mr. John Cloud
7. The Fund for the 21st Century Altai
8. Florida State Clearinghouse
9. Florida Department of State, Division of Historical Resources
10. Transcripts from Lompoc, California Canaveral, Public Hearing
11. Transcripts from Cape Canaveral, Florida, Public Hearing
12. Written Comments Received at Lompoc, California, Public Hearing

9.2 Organization

This chapter is organized into the following sections:

- **General Comment Responses.** This section provides a thorough and comprehensive response to comments received on public health and safety during launches and potential impacts to biological resources at Vandenberg AFB. These responses are provided in Section 9.3 and should be used as cross-references to individual comments, where applicable and appropriate.
- **Responses to Individual Comments.** Responses to the individual comments submitted on the DSEIS are in Section 9.4.
- **Copies of Comments (Letters and Public Hearing Testimony).** The comment letters and transcripts follow the comment responses at the end of Section 9.

9.3 General Comment Responses

Many commentors raised similar and overlapping issues. To aid both the decisionmakers and the reviewing public, the general comment responses below have been developed to address the key issues raised. The individual comment responses are cross-referenced to these General Comment Responses and, in some instances, other individual comment responses.

9.3.1 General Comment Response No. 1, Public Health and Safety During Launches

Many of the comments on the DSEIS expressed concern about measures taken to ensure the safety and health of the general public during launch events at Vandenberg AFB.

In general, the risk-management framework for health and safety for the overall EELV program is discussed in the 1998 FEIS, and the approach presented in that document has not changed since that FEIS was released. The objectives of the risk management procedures for the EELV program are to ensure that: (1) public health and safety are maximized; (2) precautions are taken to minimize exposure to offsite receptors; and (3) coordination and notification procedures are in place for the general public in the event of a launch failure. The overall approach is that, prior to any land-based vehicle launched from either CCAFS (Eastern Range) or Vandenberg AFB (Western Range), the safety offices use an air dispersion computer model, REEDM, to produce a deterministic predicted toxic plume plot. This deterministic run is part of the data used by the risk management model, the LATRA model, to produce a probabilistic output in terms of expected causalities (E_C) that is compared against existing Eastern and Western Range toxic LCC.

Range safety offices on both the Eastern and Western ranges have developed a risk management approach that is discussed in Section 3.7 of this FSEIS. REEDM is designed to take into account the fuel and oxidant load, as well as the local meteorology to predict pollutant concentrations as a function of time and distance after a launch event. REEDM uses a chemical thermodynamic program to estimate such quantities as peak temperature and cloud rise.

Specifically at Vandenberg AFB, the 30th Space Wing Safety Office (Safety) will use the REEDM air dispersion computer model to produce a deterministic predicted toxic plume plot prior to any EELV launch at Vandenberg AFB. REEDM uses launch vehicle characteristics and current weather patterns to plot predicted air pollutant concentrations expected to occur during launch of the vehicle. The model may be run several times before the launch of a vehicle to account for changing meteorological conditions. The "plume plot" produced by REEDM tracks the predicted movement, concentration, and dispersion of the clouds of emissions produced during the launch. REEDM runs are conducted to predict plume plots for both nominal and launch failure cases to ensure that all potential release scenarios are considered.

Safety performs toxic risk assessments prior to each launch that evaluate the risks to mission essential and non-mission essential personnel, including the general public in Lompoc. The calculated risks are modeled as potentially short-term, acute toxic hazards. If these calculated risks exceed the same risk level used successfully over the years to protect the

general public (less than one chance in a million for an individual), Safety recommends that the Wing Commander delay the launch until weather conditions change and the risks are brought below the launch hold criteria.

Vandenberg AFB, in coordination with the Office of Emergency Services (OES) within the Santa Barbara Fire Department, has developed emergency planning procedures over the last 11 years. The emergency planning procedures include an agreement that the Vandenberg AFB Command Post will notify the OES approximately 1 hour before liftoff when a Zone 1 toxic footprint is predicted to cross over the base property line. The location of the footprint will be identified in the Thomas Map Guide coordinates.

A Zone 1 footprint identifies the locations in which sensitive individuals could be affected by exposure to toxics. Zone 1 shelter areas could include any vehicle or structure. Zone 2 is an area where airborne concentrations of any toxic product range from a low defined by Tier 3 to an unknown high. Zone 2 is for individuals who experience breathing discomfort or skin irritation, and the shelter that is used must be fully closed. Zone 3 is an area where airborne concentrations of any toxic product range from a low defined by Tier 3 to an unknown high. Persons in Zone 3 are required to wear protective equipment or have it accessible to them.

The exposure criteria at Vandenberg AFB is used to fulfill toxic hazard and risk management requirements and policies, while maximizing range operability without compromising public and worker safety. HQ AFSPC/SG has recommended exposure criteria for some of the current solid and liquid rocket propellants and their combustion byproducts. HQ AFSPC/SG has also recommended the use of a risk-management-based approach for developing toxic LCC consistent with current human toxic exposure criteria and coordinated with Local Emergency Planning Committees (LEPC) and local agencies, as needed.

For credible potential toxic emissions, tiered levels have been established at Vandenberg AFB to fulfill Air Force requirements under AFOSH Standard 48-8, Controlling Exposures to Hazardous Materials, and LEPC requirements under Executive Order 12856 on Federal Compliance with Right-to-Know laws, EPCRA, and Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances, (USEPA, FEMA, DOT, 1987). (Table 3.7.1-1 in the FSEIS presents the Tier 1, Tier 2, and Tier 3 HQ AFSPC/SG-recommended exposure criteria.)

9.3.2 General Comment Response No. 2, Potential Impacts to Biological Resources

Many of the comments received from the City of Lompoc expressed the general concern that the analysis of potential impacts resulting from HCl deposition did not account for the specific environmental conditions and biological resources encountered at Vandenberg AFB and relied only on studies conducted at CCAFS. In response to this general concern, we have summarized the findings of relevant monitoring studies that were conducted at Vandenberg AFB during launches of vehicles using SRMs.

The DSEIS concluded that the effect on biological resources at Vandenberg AFB of adding SRMs to launch vehicles would be minimal based on monitoring of HCl deposition

associated with SRMs conducted at CCAFS for Atlas II, Delta II, and Titan IV B vehicles, and the results of REEDM modeling (Schmalzer, et. al., 1998 and DSEIS, Section 4.14). These conclusions have not changed in this FSEIS. The conclusion of limited impacts from HCl is supported by the results of several monitoring events conducted at Vandenberg AFB for smaller launch vehicles. This monitoring is described below. Section 4.14 of the FSEIS has been updated to incorporate these monitoring activities.

The effect of HCl deposition on local pH conditions was monitored on March 13, 1994, when a Taurus Small Launch Vehicle was launched from SLC-576E and on November 4, 1995, when a Delta II vehicle was launched from SLC-2. Both tests were conducted to meet the requirements of the USFWS April 12, 1993, Biological Opinion (USFWS, 1993) terms and conditions pursuant to Section 7 of the Endangered Species Act of 1973. The USFWS's concern was that HCl deposition could potentially affect federally listed bird species, such as the California least tern or western snowy plover, by burning birds, eggs, or chicks.

The March 1994 monitoring following the test launch showed that no change in pH was detected 250 yards downwind from the vehicle stand with wind velocities of 10 to 15 knots, and no pH changes were noticeable beyond a 50-yard radius in all other directions (Det 9, SMC/ENF 1994). According to the 1994 report, the results were consistent with acid plume data collected during an earlier launch of a Peacekeeper missile in 1992 from launch facility 02 (LF-02). Monitoring results from the November 1995 test indicated that the ground cloud remained within the boundaries of the launch pad and that no measurable change in pH occurred outside of a radius of 100 yards from the vehicle stand. The meteorological conditions at the time were calm winds (30 AMDS/SGBP, 1995). Contrary to what has been observed during similar tests at CCAFS, no observable signs of acid deposition on vegetation were noted during either the 1992 or 1994 test launch.

The results obtained from both of these tests were conducted with smaller vehicles than the Delta IV M+ and Atlas V 551/552 that would be launched under the Proposed Action. Because the EELV vehicles have not yet been launched, there are no monitoring data available for them. However, emissions from current launch vehicles that have smaller and larger SRM propellant quantities have been used to bracket the Delta IV and Atlas V impacts. It is assumed that the emissions from the EELV vehicles will have similar deposition characteristics to vehicles that have been monitored.

If damage to plants does occur as a result of the larger Atlas V 551/552, the Delta II and Titan IV B results indicate that it would be minor and restricted to near-field deposition. Plants generally produce new leaves as a continuous process because leaves are generally short-lived, and replacement of individual leaves can occur several times over a growing season. Under the Proposed Action, EELV vehicles with SRMs would be launched up to six times per year at Vandenberg AFB. It is expected that plants could, to some extent, replace damaged parts (leaves) between launches, depending on the interval between launches.

Future monitoring of HCl deposition under the Proposed Action could include pre- and post-launch inspection of vegetation and soil testing. Data collected would provide a more accurate assessment of the extent of HCl deposition associated with the larger Atlas V 551/552, but also of the Delta IV launches. This monitoring program would also provide information on potential accumulated and/or long-term effects of the 3.4 launches per year on average at each vehicle launch site. It is anticipated that the USFWS would require that

HCl deposition continue to be monitored for these vehicles in the Biological Opinion currently in preparation.

Commentors also raised concerns that deposition of various concentrations of acid could cause adverse effects to surface water and biota. Launches during dry weather can cause deposition of HCl at distances of about 1,000 meters or more from the launch site and can cause temporary reductions in pH in small surface water bodies. The deposition of acid-neutralizing salts resulting from the proximity of the ocean and prevailing onshore winds, however, provides sufficient alkalinity to neutralize acid falling on soils and to prevent the production of acid runoff. Similarly, acid deposited directly on water bodies would be quickly neutralized. Previous monitoring showed that Bear Creek, the stream located closest to the proposed Atlas V 551/552 launch pad (SLC-3), has alkalinities upward of 250 mg/L, which is theoretically twice the alkalinity required to neutralize acid deposited by an Atlas V launch. Similarly, Cañada Honda Creek, the stream located closest to the proposed Delta IV launch pad (SLC-6), has alkalinities of 240 to 350 mg/L, which also corresponds to approximately twice the theoretical alkalinity level required to neutralize acid deposited by a Delta IV launch. Therefore, potential adverse effects to Bear Creek and Cañada Honda Creek aquatic habitats and biota are not expected to occur because of the acid-neutralizing capacity of surface waters.

The neutralizing capacity of surface waters at Vandenberg AFB supports the observation that no measurable effects of an April 1999 Athena launch from SLC-6 could be detected on the California red-legged frog (which was listed as a federally threatened species in 1997). A comparison of pre-launch and post-launch frog survey results in the neighboring water treatment ponds failed to show launch-related effects on California red-legged frog inhabiting the ponds (Christopher, 1999a). A December 1999 Atlas IIAS launch from SLC-3 was also monitored for effects to California red-legged frogs in Bear Creek (S. Christopher, personal communication to N. Read, February 2000). Results were inconclusive because no frogs were detected before and after the launch (as a result of dry weather conditions). However, results of alkalinity measurements indicate a very high acid neutralization capacity of creek water, possibly resulting from bicarbonates in the sedimentary rock in the area, so a very low potential for acidification exists. As expected, no differences in pH measurements were detected in pre-and post-launch data.

In addition to the above behavioral monitoring conducted following the Athena launch, water quality monitoring was also conducted on the following federally listed threatened and endangered species: (1) the California red-legged frog, (2) the tidewater goby, and (3) the three-spined stickleback. Water quality monitoring was conducted for SLC-4 at Cañada Honda Creek on May 22, 1999, to assess the potential effects on these species of the larger SRM-equipped Titan IV. A similar test was conducted on June 19, 1999, during a launch of the smaller Titan II. Water quality was monitored for pH, dissolved oxygen, nitrate nitrogen, and salinity. The results did not show any launch effect on any of the measured water quality parameters. In addition, California red-legged frog tadpoles were observed in Cañada Honda Creek following the May 22, 1999, Titan IVB launch (Christopher, 1999b).

Commentors also raised concerns about the effect of noise and sonic booms on local sensitive wildlife. In the absence of actual noise data for the launch vehicles under the Proposed Action and the No-Action Alternative, launch and ascent noise were computed by

the RNOISE model and sonic booms were computed with the PCBoom3 model (see Section 4.12 of the FSEIS). Results indicate that noise levels from Atlas V launches could reach an A-weighted SEL lower than 78 dB at Purisima Point, but would create an A-weighted SEL of 81 dB at Rocky Point. Delta IV launches would create an A-weighted SEL of less than 80 dB at Purisima Point, but would create an A-Weighted SEL of approximately 95 dB at Rocky Point. The model predicted similar SELs for both the Atlas V and Delta IV launches; therefore, it is probable that the closer proximity of SLC-6 (about 4.5 miles to the south of SLC-3) more launch noise to have reached Rocky Point than Purisma Point. An extensive monitoring effort has been conducted for effects of noise and sonic booms on resident sensitive wildlife populations for each launch since 1991. Noise effect monitoring has been required by the USFWS and NMFS under a series of biological opinions and marine mammal small take authorizations (Stewart, et al., 1969; SRS Technologies, 1998a and 1998b; SRS Technologies, 1999a and 1999b). The DSEIS contained information on the monitoring, and Section 4.14 of the FSEIS has been updated to include additional information on the monitoring programs. Monitoring is conducted to monitor noise levels and observe behavioral response of Pacific harbor seals, California sea lions, northern elephant seals, northern fur seals, Stellar sea lions, Southern sea otters, least terns, and snowy plovers. In general, the research has found minimal impact to the species monitored.

The impact of launch noise is generally limited to the pinnipeds eliciting a startle response, progressing toward the water, and returning to the beach about 1.5 hours after the first response (SRS Technologies, 1998a and 1999a). Although these responses were observed for different launch vehicles, the recorded SEL covered the modeled values reported above for Atlas V and Delta IV. In all cases, pup abandonment, trampling, or extended behavioral effects (such as ceasing foraging) have not been observed. Additionally, with recent launches, monitoring has been conducted on the physiology of seal hearing and has demonstrated that a seal's hearing outside of the water is attenuated in comparison to human hearing (SRS Technologies, 1999b), indicating that physiological hearing damage is less likely for pinnipeds than for humans. Monitoring on snowy plover indicates either a lack of observable impact or flushing behavior, followed by return to previous behavior soon after the observed behavior (Read, 1996 a and 1996b).

The effects of sonic booms, which are comparable to the crackle of thunder, were evaluated in the DSEIS (see Section 4.12). Sonic booms are expected to affect the far western portion of San Miguel Islands. Effects of sonic booms on San Miguel Island pinnipeds have been monitored concurrently with the noise monitoring previously mentioned (SRS Technologies, 1999a and 1999b). Pinnipeds respond to sonic booms as they do to other disturbance —a startle response, movement towards water, and eventual return to the beach. No evidence of any injury, abnormal behavior, or mortality of any harbor seal was observed as a result of the launches (SRS Technologies, 1999a and 1999b).

9.4 Responses to Individual Comments

Comment Letter 1

U.S. Environmental Protection Agency

1-1 Comment acknowledged. The technical clarifications noted in this comment are addressed in comment responses 1-2 through 1-5.

1-2 The requested revision has been made to Table 3.10-4.

1-3 The requested revisions has been made to the FSEIS regarding the two values for ozone. The values in Table 3.10-4 has been revised and the source in the footnote of the table has been changed. A reference to the EPA's Office of Air Quality Planning and Standards Monitoring Values Reports has been added to Section 7 of the FSEIS.

1-4 The suggested text changes in the comment have been made regarding citations in the document and ODS.

1-5 The requested revisions regarding discussion of ODS have been made. Please also refer to comment response 1-4.

Comment Letter 2

National Marine Fisheries Service

2-1 The Air Force has initiated consultation with NMFS in accordance with the provisions of the Magnuson-Stevens Fishery Conservation and Management Act (16 USC et. seq.), Sections 303 and 305. The Air Force has prepared a technical report to assess potential impacts to EFH and marine fisheries resources. Preliminary results support the determination that the Proposed Action will result in no more than minimal adverse effects to EFH both individually and cumulatively. The consultation process is planned to be completed before the ROD is signed. The letters initiating consultation are in Appendix P of this FSEIS.

Comment Letter 3

Santa Barbara County Air Pollution Control District

3-1 As a result of your concern that there would be a possible PM_{10} exceedance and therefore a significant air quality impact, the air quality analysis has been refined in Section 4.10 of this FSEIS. As discussed in Section 4.10.1.2, all PM_{10} concentrations predicted by the refined air quality analysis are below the 24-hr California Ambient Air Quality Standard for PM_{10}. Details of the modeling are given in Appendix T, and the results are presented in Section 4.10 of the FSEIS.

The updated analysis includes refinement of the vehicle database and the handling of aluminum oxide particulates. Also, an additional launch-failure case (the

conflagration mode), two new meteorological cases for CCAFS, and a new normal launch scenario (enough deluge water flowing to saturate the launch cloud) have been considered in the analysis. All cases modeled in the DSEIS were remodeled, as well as the additional cases.

In addition, in the interim since the calculations for the DSEIS were performed, an updated version of the REEDM, version 7.09, has become available. This updated version was used for all cases modeled in the current document.

3-2 In the interim since the release of the DSEIS in November 1999, additional modeling work using REEDM 7.09 has been conducted (see comment response 3-1). This new work is described in Appendix T and the analyses are presented in Section 4.10 of the FSEIS. A brief summary of the meteorological conditions that were modeled are presented below in this response (see Appendix T for greater detail). Detail on the inversion criteria for the meteorological cases used in REEDM (for both CCAFS and Vandenberg AFB) are discussed in Appendix T and in Section 4.10 of the FSEIS. In addition, this comment response provides information on the meteorological cases and the inversion assumptions specifically for Vandenberg AFB.

Several meteorological cases were investigated for each launch site. The central coast of California is characterized by the presence of a strong and persistent subsidence temperature inversion. This inversion exhibits seasonal variations in height and strength and is occasionally absent, primarily during winter months. Temperature inversions also occur at CCAFS, either in association with frontal systems or the formation of the diurnal convective boundary layer. At CCAFS, the temperature inversions tend to be weaker and higher above the ground than the Vandenberg AFB inversions. The following four meteorological cases were selected for REEDM analyses of simulated Vandenberg AFB EELV launch and failure scenarios:

Case VAFB1: An October 1997 late-afternoon sounding taken in association with a Titan launch. The profile exhibits a neutral stability surface layer extending from the ground to the base of a well-defined elevated temperature inversion at 3,150 feet above the ground. Winds are from the northwest, moderate in speed with little directional shear. Measured turbulence values for the first 400 meters of the surface layer are included.

Case VAFB2: December 20, 1996, late-morning sounding taken in association with a Titan launch. A neutral surface layer from the ground to the base of a very weak mid-level inversion based at 1,500 feet above the ground is characterized by very light winds and large amounts of directional shear. Another wind direction shear zone exists across the weak inversion. Above the inversion winds are from the northwest, light to moderate in speed and with less directional shear. Turbulence measurements are included.

Case VAFB3: A May 12, 1996, afternoon sounding taken in association with a Titan launch. Winds are light to moderate in the surface layer, which extends from the ground to the base of a strong, low-level inversion at 650 feet above the ground. The potential temperature increases by 10 degrees Celsius across 400 feet

of the inversion indicating a stable layer of air. Measured turbulence is not included; hence REEDM uses an empirical and theoretical climatological turbulence model in place of the missing measured turbulence values.

Case VAFB4: This is a modification of Case VAFB2 where the large directional wind shear has been removed. Excessively large wind shears present a problem for REEDM causing the program to overestimate the cloud passage time over downwind receptor locations. Removal of the wind shear eliminates this problem. Case VAFB4 can be described as a "no-shear" condition.

3-3 The REEDM model manuals (both the 1990 and 1995 versions) and the launch criteria and emergency planning procedures, were provided to the Santa Barbara County Air Pollution Control District on December 21, 1999. Also see General Comment Response No. 1, Section 3.7 of the FSEIS and Appendix T.

3-4 Given the low frequency of launches and dispersion from atmospheric circulation, no acid fog or acid rain is expected to build up near Vandenberg AFB. Regionally and globally, there will be a small contribution to tropospheric HCl caused by EELV launches. No noticeable pH change in rain is expected as a result of dilution by background atmospheric water.

The forecast EELV launch rate from Vandenberg AFB is 6.8 launches per year over a 20-year period. On average, that is less than one launch per month. Gaseous HCl emissions from the SRMs will disperse and be diluted after each launch. The dispersion and dilution patterns depend on the meteorological conditions. HCl that reaches the free troposphere will have a lifetime of approximately 3 weeks before raining out. During that time, however, it will be diluted over an area larger than Vandenberg AFB. Similarly, chlorine emitted directly into the stratosphere will eventually be converted to HCl and will diffuse back down to the earth. In the stratosphere, intercontinental mixing occurs within approximately 3 months, whereas the lifetime of HCl is approximately 3 years. The background concentration of chlorine in the stratosphere is approximately 12 gigatons and about one-half of it rains out over 50 years. Against this background, EELV launches would not result in an increase in acid rain or fog.

Comment Letter 4

City of Lompoc

4-1 The commentor raises several issues regarding plume modeling, HCl deposition, and emergency management. Analysis, mapping, and modeling of launch plumes, including predicted transport and deposition, were provided in the DSEIS and remain in Section 4.10 and Appendix T of the FSEIS. As explained in General Comment Response No. 1, the REEDM used local weather databases as well as local topographical information to model air quality impacts in the vicinity of Vandenberg AFB, including Lompoc Valley. The results for the REEDM modeling indicate that under dry meteorological conditions with an elevated inversion, the launches conducted at Vandenberg AFB under the Proposed Action can result in deposition of HCl at distances of about 1,000 meters from the launch pad (see

Appendix R of the FSEIS). Nonetheless, both the model results and the onsite monitoring indicate that no significant impacts would result to area vegetation, including local crops (because no cultivated cropland is located beyond the 1,000-meter area). Analysis of impacts to vegetation is addressed in Section 4.14 of the FSEIS.

As stated in General Comment Response No. 1, the REEDM uses launch vehicle characteristics and current weather patterns to plot predicted air pollutant concentrations expected to occur during launch of the vehicle. The "plume plot" produced by REEDM tracks the predicted movement, concentration, and dispersion of the clouds of emissions produced during the launch. REEDM runs are conducted to predict plume plots for <u>both</u> nominal and launch failure cases to ensure that <u>all</u> potential release scenarios are considered. The explanation of the metereological cases modeled for this FSEIS is provided in Section 4.10 and Appendix R (also see comment response 3-2). Stringent procedures to minimize public health and safety risks are implemented for launches, and specific emergency response coordination is instituted during a launch failure. Greater detail on these procedures, as applicable to Vandenberg AFB, is discussed in Section 3.7 of the FSEIS and General Comment Response No. 1.

4-2 Monitoring for water quality, vegetation, and aquatic/amphibious species has been conducted during SRM-equipped vehicle launches at Vandenberg AFB, as summarized in Section 4.14 and General Comment Response No. 2. Monitoring has not indicated adverse effects on water quality, vegetation, or aquatic/amphibious species for current launch programs, and the effects of proposed launches using SRMs is adequately assessed in this FSEIS.

In addition, numerous biological surveys have been conducted at Vandenberg AFB, including a biological resource assessments for SLC-3 W (Fugro West Inc., 1996 and 1997; Hunt and Rindlaub, 1997), proposed to be used under the Proposed Action. These assessments report on the presence of a few sensitive plant species in the area adjacent to the SLC-3 W facility. These species can potentially be affected by HCl deposition. However, as the monitoring reports summarized in General Comment Response No. 2 indicate, no observable effects on vegetation are anticipated. Monitoring of these sensitive species could continue under the Proposed Action, and appropriate measures would be implemented if adverse effects are observed.

Biological and water resources monitoring currently being conducted are in coordination with biological opinions and programmatic agreements produced for current launch programs, in accordance with the respective resource agencies. In accordance with NEPA and, as indicated in the DSEIS, monitoring could be anticipated for the EELV program, depending on the outcome of consultation with the responsible resource agencies.

4-3 Section 4.12.1.1.2 of the DSEIS presented the results of noise modeling on humans from an Atlas V or a Delta IV launch and concluded that the noise level at the nearest residential community would be in the 80 dB (A-weighted) range, which is slightly less than a passing truck. In accordance with NEPA requirements, the data used to assess impacts in this FSEIS are based on best available information at the

time the document was prepared.

Monitoring for impacts to marine mammals from launch noise and sonic boom have been conducted for current launch vehicle programs, as discussed in Section 4.12 of the FSEIS and General Comment Response No. 2. See comment response 4-2 for a discussion of potential monitoring requirements for the Proposed Action. Monitoring data for Vandenberg AFB has been updated in Section 4.14 of the FSEIS.

4-4 The DSEIS states that plant communities, not individual plant species, will adjust to HCl deposition, as the plant communities have at CCAFS. It is recognized that some plant species sensitive to the increased HCl deposition could be eliminated. The results of the monitoring summarized in General Comment Response No. 2 and in Section 4.14 of the FSEIS, however, indicate no observable effects of HCl deposits on vegetation and that pH changes are limited to the area immediately adjacent to the launch pad. Although it cannot be definitively predicted which species may be eliminated, in general, species that have experienced stress from other influences are likely to be more sensitive to acid deposition and have been identified by resource agencies as requiring special protection. For a discussion on sensitive plant species near Vandenberg AFB, see Section 4.14. The conclusion that the loss of sensitive individual plant species may occur at Vandenberg AFB is based on results observed at CCAFS. Plant communities at the CCAFS site have been subjected to much higher frequency and HCl deposition level than in the Proposed Action. As a result, it is reasonable to assume that no observable impacts to vegetation could be likely at Vandenberg AFB. Also see General Comment Response No. 2 for greater detail on the discussion of applicable monitoring data.

4-5 Section 4.14 has been updated to reflect monitoring data available for Vandenberg AFB. General Comment Response No. 2 discusses that results of monitoring tests conducted during launches with SRMs at Vandenberg AFB did not show any effects on localized species. Monitoring could be required, depending on completion of the Section 7 consultation with the USFWS. Also see comment response 4-4 and General Comment Response No. 2.

4-6 The two monitoring reports completed as a requirement to observe effects of HCl deposition for current launch programs are summarized in General Comment Response No. 2. Monitoring did not show any observable effects on vegetation following launches using SRMs. The minimum amount of time needed to mobilize/demobilize a launch pad is at least 10 days (which is the minimum amount of time needed to mobilize/demobilize the launch systems), but it is more likely that the duration between launches will be greater. Based on data available for current launch programs at both Vandenberg AFB and CCAFS, it is not anticipated that long-term impacts to vegetation regeneration will occur. Monitoring, however, could be required for the Proposed Action and assessment of long-term regeneration effects may be included as part of the monitoring. Section 4.14 has been updated to incorporate additional monitoring data available for Vandenberg AFB. Also see General Comment Response No. 2 for further details.

4-7 Section 4.14 discusses the potential impact of HCl deposition for the Proposed Action on snowy plover habitat and Monarch butterfly habitat with reference to predicted plume modeling using REEDM. Snowy plover habitat is located approximately 2,400 meters west of the launch pad and would be exposed to potentially significant deposits of HCl only in the unlikely scenario of a launch occurring in rainy weather combined with an atypical offshore wind. (See Appendix R of the FSEIS for a discussion of the likelihood of launches during rain conditions.) Nonetheless, the results from the REEDM model predicted that under rare conditions, the propellant exhaust cloud could be trapped near the ground. This would result in a peak HCl deposition for the Atlas V with five SRMs of approximately 7,600 mg/m^2 within 1,000 meters of the launch pad. The concentration of HCl would decrease rapidly with distance from the launch pad (Appendix R). Impacts of HCl deposits on snowy plover habitat and other sensitive wildlife are being monitored for current launch vehicle programs. The USFWS has determined that the Atlas II launches from SLC-3 would not affect critical habitat for the western snowy plover (USFWS, 1999).

The Monarch butterfly does not have special status under the federal Endangered Species Act or the California Endangered Species Act, but is considered a special animal by the CDFG. As stated in the DEIS, Spring Canyon, a major overwintering butterfly site, is about 1.25 miles south and downwind of SLC-3. REEDM modeling indicates that potentially significant amounts of HCl would be deposited within 1,000 meters (or 0.6 mile) downwind of the overwintering site. Because Spring Canyon is located twice the distance that SLC-3 is located from the butterfly overwintering site, no impact to the butterfly habitat would be expected.

Also see Section 4.14 of the FSEIS and General Comment Response No. 2.

4-8 Section 4.14 of the FSEIS has been updated to provide information on HCl deposition monitoring on vegetation for other SRM launch programs at Vandenberg AFB. This information is summarized in General Comment Response No. 2. Based on the monitoring, substantively different impacts on vegetation at Vandenberg AFB (than those at CCAFS) are not expected, even if the HCl deposition is 10 percent higher for Delta IV launches at Vandenberg AFB than for Delta IV launches at CCAFS. Also see General Comment Response No. 2.

4-9 Section 4.14 of the FSEIS has been updated with information for water quality and biological impacts to aquatic species in Cañada Honda Creek. Also see General Comment Response No. 2.

4-10 Monitoring for current launch programs does not indicate adverse effects to water quality or biological resources from HCl deposition. Monitoring results support the discussion in the FSEIS of the likelihood of acid deposition buffered by sea spray. Additionally, Appendix R provides information on the derivation of the discussion of acid deposition buffering. Section 4.14 of the FSEIS has been updated to include information on the short-term effect of impacts to water quality and biological resources resulting from launches, and this information is also summarized in General Comment Response No. 2.

4-11 In accordance with NEPA requirements, this FSEIS considers reasonable and foreseeable alternatives. NEPA [40 CFR 1502.14(a)] requires that an EIS rigorously explore and objectively evaluate a reasonable range of alternatives. The 1998 FEIS evaluated the impacts associated with developing and operating the EELV systems, including the use of solid propellant strap-on SRMs. This FSEIS focuses on only the change from the original action considered in the 1998 FEIS, which is the use of additional and larger SRMs at Vandenberg AFB and CCAFS than were evaluated in the 1998 FEIS. The consideration of adding these new launch vehicle configurations to the EELV program was proposed subsequent to the 1998 FEIS ROD that was signed on June 8, 1998. The added SRMs are preferred to enhance capabilities and the competitive market position of U.S. launch vehicles in the world market.

Evaluating a range of alternatives that is commercially viable is an appropriate application of the "reasonable and foreseeable" criterion under NEPA. Including cost-prohibitive and commercially impractical alternatives in the DSEIS would not adequately represent a reasonable and feasible alternative. This approach is supported by NEPA [Forty Most Asked Questions Concerning CEQ's NEPA Regulations, No. 1(a), 46 Fed. Reg. 18026 (March 23, 1981), as amended, 51 Fed. Reg. 15618 (April 25, 1986)] which states:

"Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant."

4-12 The term "worst-case" scenario is not used on page 4-46 of the DSEIS to describe a meteorological condition, and none of the meteorological conditions discussed in the document has been described as a "worst-case" scenario. Rather, several representative meteorological cases from Vandenberg AFB were used in the REEDM calculations to determine potential public health and safety impacts. Prior to each EELV launch, actual meteorological conditions are input into a risk assessment model (LATRA) to determine whether or not to launch. Additionally, NEPA does not require that worst-case conditions be analyzed. Rather, reasonably foreseeable conditions were analyzed for the DSEIS. For more details on the public health and safety procedures and HCl deposition, see General Comment Response Nos. 1 and 2. For more information about the representative meteorological cases used, see comment responses 3-1 and 3-2.

4-13 Post launch calculations are made by operating REEDM on the observed weather conditions at/near liftoff to compare the predicted weather input to the observed weather profile. This is one way to measure the uncertainty in the forecast weather parameters. While this could be used to estimate the location and extent of HCl footprints, given the inherent uncertainty in meteorological instruments and atmospheric diffusion models, it should not be used as a sole means to assess actual environmental effects. Also see Section 4.10, Appendix T, and comment responses 3-1 and 3-2. In addition, refer to General Comment Response No. 2 and Section 4.14 of the FSEIS for HCl impacts to biological resources, including plant communities. See General Comment Response No. 1 for a discussion of procedures in place to ensure that public health and safety is protected.

4-14 The variety of measures and safety procedures in place to ensure resident protection in the greater Lompoc area are discussed in Section 3.7 and 4.7 of the FSEIS and in General Response No. 1. On the basis of these precautions, specific criteria are used to determine whether a launch will take place. As indicated in General Response No. 1, precautions, including the delay of a launch, are taken by using predictive modeling to ensure that public safety is not impacted. After a launch, actual meteorological conditions are used to update meteorological criteria. This enables the predictive ability and post-launch analysis to be consistently refined. These same criteria do not apply to environmental resources, however, and monitoring takes place to determine adverse effects of launch programs for these resources. As summarized in Section 4.14 of the FSEIS and General Response No. 2, these impacts are minor and temporary. Included in Section 4.14 and General Response No. 2 is a summary of several monitoring reports used to analyze the environmental effects of the Proposed Action. Complete citations are provided in Section 7 of the document. A biological opinion and inclusion of the EELV program in the programmatic agreement for "take" of marine mammals is currently in preparation. Monitoring would be addressed in that document. Analysis of the likelihood of monitoring required for the EELV program based on current monitoring programs for species and environmental conditions is included in Section 4.14 of the FSEIS.

4-15 Hydrazine handling procedures, particularly during fueling, are addressed in the 1998 FEIS, Section 4.10.1, and emissions calculated using REEDM are presented in the 1998 FEIS, Table 4.10-4, and Table 4.10-14. The predicted ambient air concentrations are compared to OSHA standards for hydrazine and were all found to be orders of magnitude below those standards. Because OSHA standards are for enclosed areas, these predictions are conservative, compared to outdoor short-term exposure limits.

The Tier 1 exposure limits recommended by the HQ AFSPC/SG were provided in the 1998 FEIS, Table 3.7-1. These values were 2 ppm for 60 minutes and 10 ppm for the ceiling limit or peak concentration that must not be exceeded during the exposure period.

4-16 The concentrations of HCl seen in previous launch vehicle plumes and expected in EELV plumes are on the order of parts per million. Although the potential exists for these concentrations to pose some risk to people exposed to them, the purpose of modeling and tracking the HCl concentrations is to reduce this potential risk. At these concentrations, however, the likelihood of chemical reactions proceeding, such as reactions with metals, oxidizers, cyanides, or sulfides, is extremely low. These reaction rates are linear in concentration; thus, at ppm concentrations the reactions are a million times slower than for pure HCl. At this very slow rate, other processes, such as dispersal of the cloud, will proceed before the reactions get under way. Hydrogen is not flammable below a concentration of 5 percent in air. HCl in ppm concentrations reacting with metals will generate hydrogen in ppm concentrations with no danger of fire or explosion.

4-17 The dissipation of HCl concentrations to Tier 1 or Tier 2 levels is a function of meteorological parameters, principally wind speed and turbulence. Humidity

levels can affect how much HCl mixes with water vapor and how much settles out as HCl gas and HCl aerosol. Section 3.7 of the FSEIS and General Comment Response No. 1 explain the procedures that Vandenberg AFB implements to prevent exposure to the public, and the actions that would be taken in the event of an emergency.

4-18 For each launch, the 30th Space Wing Safety Office at Vandenberg AFB performs toxic risk assessments that evaluate the risks ME and NME personnel, including the general public in Lompoc Valley. The calculated risks are modeled as potentially short-term, acute toxic hazards. If the calculated risks (corresponding to Tier 2 toxic exposures) exceed the same risk level used successfully over the years to protect the general public, a launch will be delayed. Greater detail on launch safety procedures and notification, as requested in the comment, is provided in General Comment Response No. 1 and Section 3.7 of the FSEIS.

4-19 The basis for the statement regarding the chance of an anomaly being extremely low is that during the period from October 1989 to October 1999, of the 72 space launches from Vandenberg AFB, four launch anomalies occurred. Three of those were destroyed by range safety and one self-destructed. The latter occurred 101 seconds after launch on a southern trajectory over the Pacific Ocean, well away from Lompoc Valley. Range safety establishes corridors for safe destruction of launches prior to each launch, based on wind, launch trajectory and other parameters. Greater detail on launch safety procedures is provided in General Comment Response No. 1 and Section 3.7 of the FSEIS.

4-20 The commentor had questions regarding potential debris impacts in populated areas north of the site, whether modeling had been conducted, and if there were a change in this potential from the addition of SRMs. Because space launches from Vandenberg AFB have southerly trajectories, a debris footprint north of the launch site could occur only in what is called a "malfunction turn" scenario. In such a case, the Mission Flight Control Officer would command destruct of the vehicle shortly after the malfunction turn is detected, ensuring that the debris remains within established corridors. Typical debris-impact corridors were modeled for the EELV program and are shown in Appendix Q of the SEIS. Similar modeling is conducted as a part of the launch planning process. As described in Section 3.7 of the 1998 FEIS, impact limit lines and associated flight termination boundaries are plotted for every space launch. These modeled corridors take into account launch vehicle characteristics, trajectory, and meteorological conditions to identify flight boundaries that prevent debris impact on populated areas in the event of a launch failure or termination. This type of analysis is conducted for all current space launches at Vandenberg AFB and will be conducted prior to the launch of any EELV vehicle. Because the launch-planning process is conducted individually for each launch and trajectory to minimize potential for impact outside of limit lines, and because the trajectories planned for use with the addition of SRMs are not substantially different from those without, no increased potential for launch debris outside of impact limit lines is expected with the addition of SRMs. The commentor's reference to a "10-mile radius" is not understood. Unless a launch failure or destruct happens immediately above the pad, the debris is usually

scattered in a corridor along the trajectory of the vehicle rather than a radius. In any case, the debris patterns for the EELV vehicles with SRMs are not substantially larger than medium EELV vehicles without SRMs and are most likely somewhat smaller than the debris patterns associated with the heavy-lift versions of the EELV vehicles addressed in the 1998 FEIS.

4-21 The debris area for the scenario of destruct at T-90 for a Delta Vehicle has been added to Appendix Q of the FSEIS.

4-22 In reference to the comment about the effect of multiple launches on plant communities, please refer to response to comment 4-6. Also refer to General Comment Response No. 2.

4-23 In reference to the comment about comparisons between Vandenberg AFB and CCAFS, see response to comment 4-8. Also refer to General Comment Response No. 2.

4-24 The response refers to Section 4.14.1 of the DSEIS (and the FSEIS), which provides a summary of a range of potential effects to biological resources as a result of the Proposed Action for both Vandenberg AFB and CCAFS. The specific impacts that could be expected from payload farings and discarded stages falling into the ocean are provided in Section 4.14.1.1.1, and incorporation of this section by reference is made to Sections 4.14.1.2.1 and 4.14.1.2.2. In addition, the Air Force has initiated consultation with NMFS on EFH and managed fish species (see response to comment 2-1).

4-25 As part of the current monitoring requirements under Section 7 consultation, the USFWS reviews the monitoring results on a regular basis. Under this current requirement, the USFWS would reinitiate consultation with the Air Force, if adverse impacts to biological resources are demonstrated, and it is likely that mitigation measures would be determined with the USFWS. Section 7 consultation for the EELV program will result in a biological opinion being issued by the USFWS, and it is likely that the Air Force will continue to remain under similar requirements for the EELV program.

4-26 Impacts to wildlife from HCl deposition are included in Section 4.14 of the FSEIS. In the interim since the DSEIS was released in November 1999, additional information on potential impacts from HCl deposition on wildlife has been updated. Please see General Comment Response No. 2. Also see response to comment 4-7.

4-27 Impacts to threatened and endangered species from HCl deposition are included in Section 4.14 of the FSEIS. In the interim since the DSEIS was released in November 1999, additional information on potential impacts to threatened and endangered species from HCl deposition has been updated. Please see General Comment Response No. 2. Also see response to comment 4-10.

4-28 Impacts to plant communities from HCl deposition and monitoring activities are included in Section 4.14 of the FSEIS. In the interim since the DSEIS was released in November 1999, additional information on impacts to plant communities and monitoring activities has been updated. Please see General Comment Response

No. 2. Also see comment responses 4-4, 4-5, and 4-6. Potential impacts to vegetation as a result of implementing the Proposed Action are discussed in Sections 14.14.1.2.1 and 14.14.1.2.2. The vegetation maps that were in the DSEIS (and are in the FSEIS) are derived from biological surveys conducted at Vandenberg AFB (see Figures 4.14-3 and 4.14-4). The field studies were conducted by Bionetics Corporation on behalf of the Air Force in 1997.

4-29 In accordance with NEPA requirements, the data used to assess impacts in this FSEIS are based on best available information at the time the document was prepared. The statement in the DSEIS (page 4-139) that is referenced by the commentor is the acknowledgement that, in the absence of data specific to SLC-3W, monitoring data from other sites are used as a basis for comparison, where applicable. Please see General Comment Response No. 2. Additionally, Section 4.14.1.2.1 of the FSEIS has been updated to incorporate available information on environmental monitoring for other launch programs at SLC-3W, as required by the USFWS and NMFS.

Comment Letter 5

Thiokol Propulsion

The following documents submitted have been added to the administrative record for the FSEIS and have not been reproduced here. These documents include: a paper presented by A.J. McDonald at the IAA-99 meeting, a letter from EPA to Thiokol regarding a Russian report, a list of attendees at the IAA meeting, and a table of exhaust species from historic U.S. launch vehicles with an unidentified source. To respond to your comments, we have categorized them as follows: cover letter from Mr. Allan McDonald, general notes from Dr. Robert Bennett, and specific comments also by Dr. Bennett.

5A Thiokol Propulsion, cover letter from Mr. Allan McDonald

Your letter contains a statement that "the SEIS clearly attempts to make solid rockets appear far more damaging to the stratospheric layer…." The purpose of any EIS is to analyze the potential environmental impacts for any major federal action. Sections 1 and 2 of the SEIS explain the rationale and need for the SEIS, which is to support a decision whether or not to allow the use of larger and more numerous SRMs on EELV medium vehicles. The core boosters for EELV were analyzed during preparation of the 1998 FEIS and their use was approved in the associated ROD. Because the Proposed Action is the expanded use of SRMs on EELV launches, only issues directly related to the addition of those motors are addressed in the Proposed Action analysis. This appears to be the reason for the perception that potential impacts related to the use of SRMs is emphasized. Potential stratospheric impacts from EELV components other than the SRMs (in particular the LO_x/kerosene and LO_x/H_2 core boosters) were covered in detail in the 1998 FEIS and were summarized, where relevant, as part of the No Action Alternative analysis in the SEIS. Review of the 1998 FEIS in combination with the SEIS provides the most comprehensive detail for all aspects of the EELV program.

The statement in the 1998 FEIS that Atlas V would produce no estimated emissions of ODS refers to the fact that no regulated ODS are predicted to be emitted by the RD-180 engine.

The author asserts that a statement regarding Atlas V emissions in the 1998 FEIS contradicts World Meteorological Organization (WMO) assessments in 1991 and subsequent years. The WMO assessments were actually used as references in the preparation of the 1998 FEIS, as noted on page 7-24, which lists both the 1989 and 1994 reports. The 1994 WMO report was more current than the 1991 report. The 1991 WMO report concludes that "the total annual addition to stratospheric chlorine from rocket launches is of the order of 0.25 percent of the global annual stratospheric chlorine source...." In addition, "If the annual background source from halocarbons is reduced and/or the launch rate increases, the fractional contribution will become larger." This is entirely consistent with the analyses and conclusions of the SEIS. Both the 1998 FEIS and the FSEIS contain predicted launch rate scenarios that differ from those used in the preparation of the WMO report (EELV was not a program at that time), yet the order of magnitude of cumulative EELV launch impacts to global stratospheric ozone agrees with the overall conclusions of the 1991 and subsequent WMO reports. It has been necessary to update launch rates, vehicle configurations, engine characteristics, and other parameters for the EELV systems, rather than using the conclusions of older WMO reports based on Shuttle and Titan scenarios, directly.

The letter also asserts that the SEIS "ignores real scientific measurements and data collected" from actual flythroughs conducted under the Rocket Impact On Stratospheric Ozone (RISO) and Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT) programs. Several critical references that were used in the analysis of impacts were inadvertently omitted from the references list in Section 7. The missing references have since been reinserted in the FSEIS. Specifically, Section 3.11.2, Stratosphere, incorporates two RISO/Accent studies to provide background information on Titan IV launches, along with several other experimental and computational studies. Furthermore, the RISO/Accent studies were used in arriving at scaling factors for EELV specific estimates of impacts, as noted in Tables 4.11-4 and 4.11-8. It should be noted that the RISO/ACCENT flythroughs did not measure EELV emissions, but did measure distinctly different launch vehicles, so the analysis of EELV impacts cannot be based solely on those studies. The studies provide good background information, more relevant to the No Action Alternative of the 1998 FEIS than to the FSEIS. In particular, RISO/ACCENT data for Atlas II AS and Delta II flights are mentioned in the comment letter. See comment response 5B-14, below, for more information on these data. These data are specific to those two earlier vehicles and not to EELV engines, but provide useful background information for the No Action alternative to the FEIS. However the publicly released report documenting those findings has only recently been finalized (Ross, et al., submitted to GRL, approximately December 1999). The upper atmosphere analyses in both the 1998 FEIS and the FSEIS rely on final studies that are available in the public domain. This recent publication indicates that a simplistic chlorine mechanism for ozone depletion may not be enough to account for all of the observed ozone loss from the Delta II vehicle. It does not provide more specific data that would change the conclusions of the FSEIS.

The 1998 FEIS provides a full description of the Atlas V vehicle configuration, in particular how it differs from current Atlas vehicles. The RD-180 closed-cycle engine with high combustion chamber pressures is considerably different from the LO_x/kerosene engines in the current Atlas vehicles. Therefore, direct comparisons cannot be made between these two systems, as the comment letter asserts.

Two paragraphs in this letter discuss Russian reports or news articles that were not used in the FSEIS analyses. The author's concern with the validity of these issues is noted. Our findings are consistent with the EPA letter that you provided. In essence, emissions from rocket motors do not contribute considerably to ozone depletion and are, therefore, considered insignificant. This conclusion is supported by our analysis that indicates the yearly EELV contribution to the total annual global ozone decrease has been estimated to be less than 0.1 percent of existing conditions.

5B.1 Thiokol Propulsion, Cover Letter, Dr. Robert Bennett

Refer to Comment Response 5A, above, regarding missing references from RISO/ACCENT studies and how those are relevant to the EELV program. To understand the full level of details regarding the RD-180 LO_x/RP-1 engine considered in the EELV analysis review both the 1998 FEIS and the FSEIS must be reviewed together. In the background Section 3.11.2 Stratosphere, a variety of experimental, flythrough and computational peer-reviewed studies are cited to provide a framework for the analysis in Section 4.11. While the author of the comments may have a preference for certain references from the RISO/ACCENT program, Section 3.11.2 must summarize approximately two decades of scientific information on this subject area. Therefore, it contains a representative and balanced selection of those studies. For a more comprehensive or detailed review of the subject matter, the reader must refer to the original scientific literature or to any of several review articles on the subject.

The author refers to implications of soot impacts from current generation Atlas and Delta vehicles. There are no data to support these mechanisms of ozone depletion occurring with the use of the RD-180 EELV engine. In fact the engine characteristics described in the 1998 FEIS and the emissions modeling indicate no specific pathways for soot formation. The analysis on which this conclusion is based was performed for the 1998 FEIS. Any emissions less than one millionth of the total mass of emissions are not listed in the tables in Section 4.11 of the FEIS and FSEIS because those are considered insignificant.

5B.2 Specific Comments from R. Bennett

5B-1 The words "or nitrogen" have been deleted from the sentence in Section 3.11-2.

5B-2 The following text change has been made to the document in Section 3.11.2, "and split into a halogen (chlorine or bromine) molecule and an organic radical. The atomic chlorine or bromine acts as ...."

5B-3 The following text change has been made to the document in Section 3.11.2 : changed sentence to read "single chlorine molecule can lead to the destruction of many ozone molecules."

5B-4 The following text change has been made to the document in Section 3.11.2: Revised sentence to read "the residence time of chlorine containing compounds such as HCl in the stratosphere is on the order...."

5B-5 The following text change has been made to the document, paragraph 2: "No Class I ODS will be utilized in the EELV program; the use of Class II ODSs will be minimized or eliminated." See response to comment 1-5 for other clarification on use of acronym ODS.

5B-6 Although ClO is generally short-lived, rocket engine performance codes indicate that a small quantity of ClO is produced at the exit plane of SRMs, in addition to Cl_2.

5B-7 NO_x is not considered an ODS, according to regulatory definitions. See response to comment 1-4 for clarification of that acronym.

However, NO_x does react with ozone in the stratosphere, so the analysis of those emissions is included in the FEIS and SEIS. NH_2ClO_4/Al/binder-fueled motors, hydrazine-fueled motors, LO_x/kerosene motors, and LO_x/H_2 motors all produce NO_x through afterburning in the exhaust plume. Ambient N_2 is entrained in the plume and can produce NO_x through more than one pathway. Comparative studies show that SRMs tend to produce more NO_x than liquid-fueled motors in the stratosphere, because SRMs generally have higher nozzle and plume temperatures than liquid motors. The NO_x emissions for the EELV liquid core EELV boosters were quantified in Section 4.10 of 1998 FEIS.

The scope of the SEIS is defined to focus on issues related to the addition of larger, and more numerous, SRMs to the EELV medium configurations. Because this is an SEIS, much of the 1998 FEIS (particularly sections pertaining to the core boosters) is incorporated by reference, so is not repeated in the SEIS.

The text states that "nitrogen compounds (NO and N_2)" are emitted into the stratosphere because N_2 afterburns to produce NO_x compounds in the stratosphere in SRM exhaust plumes.

5B-8 Comment Noted.

5B-9 The following text change has been made to the SEIS, Section 3.11.2: "...depletion of ozone in the daytime when sunlight is available." "Burke, M. L. and P. F. Zittel, *Laboratory generation of Free Chlorine from HCl under Stratospheric Afterburning Conditions, Combustion and Flame,* Vol. 112, 210-220, 1998" was added as a reference to provide further information on the afterburning conversion of HCL to Cl_2/Cl. In the daytime, at the stratospheric altitudes of interest, the rapid interconversion of Cl_{22} to Cl supports the assumption that the chlorine is available in an active form.

5B-10 The following text change has been made to the SEIS and added to the reference section to provide in situ data relevant to afterburning: M.N. Ross, J.R. Benbrook, W.R. Sheldon, P.F. Zittel and D.L. McKenzie, "Observation of Stratospheric Ozone Depletion in Rocket Plumes," *Nature*, 390, 62-65, 1997. The following text change has been made to the document, Section 3.11.2: delete "(2) providing a surface that promotes photolysis of CFC, thus freeing chlorine."

5B-11 Please see comment response 5B-7 regarding afterburning of N_2 to NO_x. The discussion of nitrogen chemistry was not omitted from the FEIS. The NO_x emissions for the EELV liquid core EELV boosters were quantified in the 1998 FEIS (for example, Tables 4.11-2, 4.11-3, 4.11-4, 4.11-5, and 4.11-6). See comment response 5B-7 regarding incorporation of FEIS data into the supplemental document.

5B-12 The statement in the SEIS regarding long-term versus short-term effects of Al_2O_3 is supported by the published studies cited in the SEIS. The reaction probability for ozone destruction on alumina has been measured and is relatively slow. Globally, in the long term, reactions on Al_2O_3 (including those of reservoir species) may be more significant, as noted in the following reference that has been added to the SEIS: Molina, M.J., L.T. Molina, R. Zhang, R.F. Meads, and D.D. Spencer, "The reaction of $ClONO_2$ with HCl on aluminum oxide," Geophys. Res. Lett., 24, 1619-1622, 1997.

The comment notes that the surface area of particles is a factor in the overall rate of ozone destruction on alumina. It is true that reaction probabilities are combined with surface areas for overall destruction rates, but this does not make the short-term/long-term discussion incorrect. The SEIS discussion does not include the level of detail at which surface area of rocket exhaust particles are discussed. Several independent studies discuss this aspect of SRM plume impacts. No surface area measurements for Al_2O_3 emitted in the stratosphere from EELV vehicles are available. See comment response 5B-13 for more information.

5B-13 The impact of Al_2O_3 particle size is discussed in detail in the paper by Jackman, et al., 1998, including a table showing the effect of limiting distributions of particle size on ozone destruction. The reader is referred to that reference for more detail on this subject and the effect of changing assumptions in the global model. No attempt was made in the SEIS to change the original assumptions about particle size in Jackman's computation because no data for particle sizes specific to EELV SRMs are available. Jackman states that the contribution to ozone destruction by Al_2O_3 is approximately one-third while that from chlorine is approximately two-thirds. Any change to particulate areas in his 1998 scenarios would only affect, at most, one-third of the reported ozone depletion.

5B-14 The published RISO/ACCENT studies cited in the SEIS with respect to the Titan IV vehicle actually measured chlorine compound concentrations and ozone concentrations. These studies are in agreement with the computational studies, particularly those concerned with afterburning. While current mechanisms for ozone destruction by chlorine compounds may not be complete enough to account for all of the ozone caused by current launch vehicles such as Atlas and Delta, there are currently no data on mechanisms by which substances other than chlorine (and Al_2O_3) contribute significantly to ozone depletion from launch vehicles. A RISO/ACCENT study submitted for publication by Ross, et al. (Geophysical Research Letters, 1999) simply illustrates how a simple chlorine destruction mechanism does not account for all of the ozone loss measured. Other chemical mechanisms must be investigated before unequivocally implicating soot or other substances.

The reactivity of HO_x with O_3 is much less than that of Cl_x with O_3. Water (H_2O) emissions from each of the EELV launch vehicle variants were calculated in the preparation of the 1998 FEIS, but studies have shown that HO_x mechanisms are relatively insignificant compared to those for the substances listed in the FEIS.

5B-15 Refer to Tables 4.11-6 and 4.11-9 for quantities of NO_x emitted by the EELV vehicles with SRMs. The comment is correct in stating that NO_x was also implicated in the study of shuttle emissions by Pergamment, et al.

5B-16 Comment noted. Published data were reviewed and did not substantiate any statement other than the text.

5B-17 The reader is referred to response to the 5A regarding references that were inadvertently listed incorrectly in the DSEIS. Two references were inadvertently combined in the DSEIS that was released for public comments. The following text change has been made to the document, Section 3.11.2, "nighttime" was changed to "daytime." The reference to Ross was changed to Ross, et al. (1997a). The following sentence was added to pg. 3-14, end of paragraph 3. "A second study by Ross, et al. (1997b) showed elevated chlorine levels, but no significant ozone depletion at 18.9 km following a twilight Titan IV launch."

The following reference, inadvertently left off of the reference list in the DSEIS, was added to the FSEIS: M.N. Ross, J. O. Ballenthin, R.B. Gosselin, R.F. Meads, P.F. Zittel, J. R. Benbrook, and W. R. Sheldon, "In-situ measurement of Cl_2 and O_3 in a stratospheric solid rocket motor exhaust plume," Geophysical Research Letters, Vol. 24, 1755-1758, 1997.

5B-18 Again see responses to 5B-17 and 5A and other comments regarding the references missing in the DSEIS to which this comment refers. The reference list and citations in the text of the SEIS have been corrected. The following text change has been made to the document, Section 3.11.2,the words " et al." were added to reference in text and "and Ross" to reference in list.

Contrary to what the comment asserts, RISO/ACCENT data were used in the preparation of Section 3.11. This section provides background information to the reader on stratospheric effects of launch vehicles with SRMs and, as such, must present a representative, balanced selection of the experimental, computational, and in situ studies. The commentor's preference for more emphasis on the RISO/ACCENT studies is acknowledged.

5B-19 The impacts of EELV LO_x/RP-1 engines on the thermal balance, including those from CO_2 and H_2O emissions have not been omitted. Refer to FEIS, pg. 9-22, Table 9-3, Radiative Forcing Effects, and pg. 4-135 paragraph 3. A discussion of the natural background water and CO in the stratosphere compared to that from the EELV concepts is included in the FEIS, pg. 9-21, paragraphs 2 and 3. Again, the FSEIS incorporates these data dealing with the FSEIS No Action Alternative by reference. Note that CO_2 is formed from the oxidation of CO, which is the launch vehicle emission compound reported in the FEIS. The reader is referred to the reference, Jackman, 1998, for details on the prediction of Al_2O_3 effects on global ozone, which, in turn, affects the thermal balance in the stratosphere.

5B-20 The reader is referred to the legend of Table 4.11-2, where "particulate" is defined as the sum of Al_2O_3 and other alumina-containing species.

Emissions from the LO_x/RP-1 fueled Atlas V core vehicle were analyzed and

reported in the 1998 FEIS, Sections 4.10 and 4.11. The reader is referred to the 1998 FEIS, pg. 4-94, paragraph 4, for a specific discussion of why the Atlas V vehicle is not predicted to produce a significant amount of soot. The RD-180 is a closed-cycle engine with a high combustion chamber temperature, so is considerably different from the LO_x/kerosene engines used in current U.S. government launch vehicles. This FSEIS supplements the 1998 FEIS and does not reiterate analyses presented in the FEIS, but adheres to the Description of Proposed Action and Alternatives described in Sections 1 and 2. Emissions from the LO_x-RP-1-fueled Atlas V core vehicle were analyzed and reported in the FEIS, Sections 4.10 and 4.11.

The RD-180 engine as noted in the FEIS, pg. 4-94, is not similar to an aircraft engine, so the reference presented in the comment is not relevant to the current SEIS analysis.

5B-21 Cl_x is specifically defined in the legends of Tables 4.10-1 and 4.10-2, for the specific purposes of the FSEIS.

5B-22 The author is referred to FSEIS Tables 4.11-8 and Table 4.11-4 where RISO data for a Titan IV vehicle are shown for comparison. The calculated "hole" duration of 25 minutes in daytime agrees with the measured "hole" time of 30 minutes, but these were at different altitudes. The interpolated values for EELV vehicles are defined at 20 km, whereas the RISO measurement began at 18 km and then the altitude was not held constant. The EOS article cited in the comment has been published since the SEIS Section 4.11 was completed. It does contain one figure showing nearly complete ozone destruction in the wake of an Atlas IIAS, but does not contain numerical values for altitude, time of launch, mechanisms causing the ozone loss, or other needed information to incorporate it into the SEIS. In the first paragraph of the comment, the statement is made, "In reality ozone loss in the plumes of the Delta II and Atlas IIAS vehicles lasts about as long as it does for the Titan IV and Shuttle vehicles—on the order of 1 to 2 hours." This comment seems to be implying that EELV vehicle impacts should also last on the order of 1 to 2 hours. However, there is no evidence to support this same duration for the EELV vehicles. The EELV vehicles have unique configurations and considerably smaller SRMs than the Titan IV and Shuttle vehicles. For this reason, the analysis presented in the SEIS Section 4.11 is based on scaled extrapolation from Titan IV hole duration estimates.

The second paragraph of the comment mentions background published studies described in Section 3.11 for non-EELV launch vehicles compared to actual EELV estimates presented in Section 4.11. This sectioning is appropriate because the standard NEPA document format presents impacts associated with the Proposed Action in Section 4. These are generally not discussed in Section 3. Again, the comment seems to be implying that measurements for other launch vehicles (Delta II, Atlas IIAS, Titan IV and Shuttle) are directly applicable to EELV vehicles.

The titles of SEIS Tables 4.11-4 and Table 4.11-8 state that the estimates of ozone

depletion were made specifically for an altitude of 20 km.

The SEIS scope is defined in Sections 1 and 2 of the SEIS to include impacts caused by the addition of larger or more SRMs to the EELV systems. Hence this analysis is focused on emissions from the SRMs, the most significant emissions are the chlorine compounds.

5B-23 The following text change has been made to the SEIS: Section 4.11.3, the sentence beginning: "However secondary combined impact from...." was deleted.

5B-24 The Jackman (1998) paper reports estimated AAGTO percent change from a steady-state prediction as stated in Section 4.11. Jackman reports the predicted contribution to annual global ozone reduction from launches. No change to the estimate of long-term EELV global impacts, which was based on a simple scaling of quantities used in Jackman's computation, is warranted. The order-of-magnitude result given in Section 4.11 is consistent with the findings in the Jackman paper.

The SEIS does not attempt to change the fundamental assumptions made in the Jackman study, in particular with respect to surface area of alumina particles. There are no measured surface areas for Al_2O_3 particles emitted from EELV vehicles so this would not be an appropriate manipulation of the Jackman work. The simple approach described in the SEIS for making estimates of EELV global impacts is based on changing overall quantities of propellants emitted into the stratosphere. See responses to comments 5B-12 and 13.

5B-25 Emissions from the LO_x-RP-1-fueled Atlas V core vehicle were analyzed and reported in the FEIS, Sections 4.10 and 4.11. The reader is referred to the FEIS, pg. 4-94, paragraph 4, for a specific discussion of why the Atlas V vehicle is not predicted to produce a significant amount of soot. The RD-180 is a closed-cycle engine with a high combustion chamber temperature, so is considerably different from the LO_x/kerosene engines used in current U.S. government launch vehicles.

The author states that it is not clear to him that the No Action alternative will result in any less impact on stratospheric ozone than the proposed use of SRM strap-on rockets. The assertions made in the comment about soot from the RD-180 engines contributing to ozone depletion are speculative and are not supported by any data. The RISO/ACCENT study mentioned in the comment (Ross, et al., submitted to GRL, 1999), as well as in Comment B-14, noted that a simple chlorine mechanism cannot account for all the ozone loss observed in the wake of current generation launch vehicles. It does not contain data specific to any mechanisms on soot particles, which can quantitatively account for the additional ozone loss. As discussed in several comment responses above, those data were obtained for engines other than the RD-180, which is not expected to perform in a similar manner.

5B-26 There are no in situ experimental data available for EELV upper atmosphere emissions, because the first launch is not scheduled until 2001. It is assumed that if such data become available in the future, global and local models of launch impacts on the atmosphere will incorporate these data. The RISO data mentioned

in this comment were not obtained from EELV vehicles, the FSEIS analyses cannot be based solely on those data. Thus the statement in the comment that "The whole question of the potential for localized ozone holes has been answered with the RISO data" is not adopted as the basis for the FSEIS analysis. EELV vehicles have unique configurations and engine characteristics, so that impacts must be estimated from a combination of available models, laboratory data, and field data, as was done in Section 4.11.

Comment Letter 6

Mr. John Cloud

6-1 The commentor is referring to comments submitted on a separate and unidentified environmental review document for the Channel Islands National Marine Sanctuary. These comments are outside the scope of this FSEIS. Cumulative impacts of the Proposed Action for this FSEIS in the context of launch-related military activities at Vandenberg AFB is discussed in Section 2. Potential impacts to the Channel Islands for this Proposed Action are addressed under Section 4.14, Biological Resources. Section 4.14 and Appendix P of the FSEIS provide information on the status of consultation with NMFS on EFH marine fisheries resources.

Comment Letter 7

The Fund for the 21st Century Altai

7-1 The DSEIS discusses a wide range of environmental impacts that have the potential to occur as a result of implementing the Proposed Action of using larger and additional SRMs for the Delta IV and Atlas V systems. In addition to the public health and safety concerns addressed in Sections 4.5 (Utilities), 4.6 (Hazardous Materials and Hazardous Waste Management), and 4.7 (Public Health and Safety), the FSEIS assesses potential impacts to the global environment associated with orbital debris (Section 4.13). The Proposed Action in this FSEIS would not contribute any change in orbital or deorbiting debris assessed in the 1998 FEIS, because the SRMs would burn out and drop long before the vehicles reach Earth's orbit. In addition, there would be no cumulative impacts from orbital debris as a result of implementing the FSEIS Proposed Action. The FSEIS is consistent with U.S. EPA findings that the use of ODS would not result in significant impacts to the ozone layer.

In addition to the sections referenced above for the FSEIS, see General Comment Response No. 1, Public Health and Safety During Launches, for a discussion of safety procedures incorporated into launch systems decisions. The FSEIS is consistent with U.S. EPA findings that the use of ODS in accordance with their use specified in this document will not result in significant impacts to atmospheric ozone.

Comment Letter 8

Florida State Clearinghouse

8-1 The Florida State Clearinghouse coordinated the comments from various state agencies. Comment acknowledged.

Comment Letter 9

Florida Division of Historical Resources

9-1 Comment acknowledged.

Comment 10

Vandenberg AFB Public Hearing Transcripts

10-1 Santa Barbara County Tax Payers Association (Justin Ruhge)

The commentor has suggested taking a middle-course approach when considering the environmental impacts under of the Proposed Action. Under NEPA, environmental impacts are required to be evaluated for numerous resource areas, including air, water, biological and cultural resources, and geology and soils. In addition, impacts to local communities, land use, public health and safety, and utilities must be thoroughly addressed to ensure informed consideration by decisionmakers. In accordance with NEPA, this FSEIS presents a rigorous evaluation of impacts to these resources and the potentially affected communities. In addition, this FSEIS was prepared in consultation with all appropriate resource agencies to ensure a balanced consideration of environmental impacts.

10-2 Joel Nevels

The commentor has requested information about the duration of the EELV program. Information on the duration and nature of the program can be found in Section 2.1 of the FSEIS and in the 1998 FEIS. The acquisition strategy of the EELV program is to purchase a launch service from industry suppliers through 2020. As indicated in the response to this comment during the public hearing, any new technology used for this program would be suggested by the two EELV contractors currently under contract to the Air Force to use the new technology. Any technologies proposed by other contractors in industry would most likely be suggested to the EELV contractors for consideration. An evaluation of the relevance of incorporating the new technology into the program would take place at that time.

10-3 Volunteers for a Healthy Valley (George Rorh)

The commentor expressed concern about water runoff to the Pacific Ocean from launch activities at Vandenberg AFB. Section 4.9 of the FSEIS provides information on the potential impacts to surface water quality, including the

ocean, from launch activities. Runoff to the ocean from launch-related water use would not have a significant impact on water quality. Water used for the Delta program will be collected and treated onsite, and then reused for launch-related activities. Water for the Atlas program will be collected and trucked offsite to a wastewater treatment facility.

10-4 Volunteers for a Healthy Valley (George Rorh)

The commentor has expressed concern about the effects of acid deposition from launches on wildlife and wildlife habitat in the vicinity of Vandenberg AFB. Section 4.14 of the FSEIS provides information on the potential impacts of acid deposition on vegetation, wildlife, threatened and endangered species, and sensitive habitats. Additionally, refer to General Comment Response No. 2 and the responses to comment letter 4, above.

10-5 Volunteers for a Healthy Valley (George Rorh)

The commentor has requested information on how it is determined whether launch emissions reach the Lompoc Valley during a launch and whether air-quality monitoring is being performed. Section 3.7 and 4.7 of the FSEIS provides information on specific programs in place to reduce risk to the health and safety of the public as a result of launch activities. Section 4.10 and Appendix T provide information about modeling performed to minimize impacts to air quality. Both of these section provide information on how actual monitored data are input to the model to continue to improve the accuracy of the model. Additionally, refer to General Comment Response 1, Public Health and Safety During Launches.

10-6 Volunteers for a Healthy Valley (George Rorh)

The commentor asks for information on the number of missiles being launched at Vandenberg AFB. A total of 149 launches have occurred from VAFB during the October 1989 to October 1999 time period. Of those, 77 were ballistic missiles and 72 were space launch vehicles. Section 2 of the FSEIS provides information on the number of vehicles projected to be launched for the EELV program. Please see the figure that follows comment response 12-4.

10-7 Volunteers for a Healthy Valley (George Rorh)

The commentor has asked if the deployment of a launch depends on wind direction. Launch activities depend on local meteorological conditions (as discussed in Sections 3.7, 4.7, 4.10, and Appendix T of the FSEIS), primarily to minimize risk to the public. Additionally, refer to General Comment Response No.1, Public Health and Safety During Launches, and General Comment Response No. 2, Potential Impacts to Biological Resources. Also see comment response 3-2.

10-8 Volunteers for a Healthy Valley (George Rorh)

The commentor has requested information on programs that define the type of emissions and reduce the potential of launch emissions reaching the public. The commentor also requests that potential cumulative impacts from local pesticide use and launch-related emissions be provided. Information on reduction of the

risk of launch emissions reaching the public are provided in Sections 3.7 and 4.7 of the FSEIS. Potential cumulative air-quality impacts are discussed in Section 4.10 of the FSEIS.

The proponents of the Proposed Action have reviewed a report from the OEHHA investigating which illnesses in the Lompoc area occur at a higher rate than would normally be expected in California, potentially from pesticide sources (OEHHA, 1998). The report found that elevated hospital discharges for respiratory illnesses and increased incidence rates for lung and bronchus cancers existed in Lompoc relative to the comparison areas. However, the report did not conclude the cause of these concerns. Determination of causality of these findings with respect to the potential combined effects of local area pesticide use and launch emissions is beyond the scope of this FSEIS. VAFB will continue to provide input to OEHHA studies, as Air Force policy allows. Additionally, refer to General Comment Response No. 1, Public Health and Safety and General Comment Response No. 2, Biological Resources.

10-9 Volunteers for a Healthy Valley (George Rorh)

Criteria pollutants are considered in NEPA documents (and in this FSEIS) because these pollutants are considered in determining whether NAAQS have been exceeded and whether an air district is in attainment with these standards. In addition to criteria pollutants, other pollutants of concern were addressed in Section 4.10 of the FSEIS.

10-10 Volunteers for a Healthy Valley (George Rorh)

The commentor requested a comparative discussion of the potential for launch failure between a failed Titan 4D launch and the Proposed Action. Additionally, the commentor asked for an explanation of the potential effects of a failed launch of the Proposed Action, specifically with regard to public safety. The differences in vehicle configuration and materials different from the Proposed Action that may contribute to the lower likelihood of launch failures are discussed in the transcripts. Further explanation of planning procedures in place to minimize risk to the public and emergency actions that would be taken during and after a failed launch are found in Sections 3.7 and 4.7 of the FSEIS and General Comment Response No. 1, Public Health and Safety. See Appendix Q of the FSEIS for a discussion of debris footprint analysis for possible launch failure. Also see Appendix T for data on above-the-pad failures (Figures 6, 7, 8, 16, 17, and 18).

Comment 11

Transcripts from CCAFS Public Hearing

11-1 Brevard County Emergency Management, Allison Hansen

Throughout the preparation of this document, numerous parties have participated in the review of interim drafts and the public DSEIS. The DSEIS was mailed to 160 individuals, agencies, and organizations for public comment. The 45-day comment period ended on December 27, 1999. In addition to resource agencies, organizations, and individuals that received the DSEIS, the 45th Space Wing has participated in review of the FSEIS. In addition to ensuring that the description of programs implemented for emergency management were accurate, the 45th Space Wing contributed to describing the role of local county emergency management agencies coordinating with the Wing to minimize risks to public safety.

11-2 John Herrman

The Proposed Action for the FSEIS is to authorize use of the SRMs for both government and commercial launches. The cost of lifting heavier payloads into space with the originally configured "heavy" vehicles is more than the cost of using MLVs to lift the same payloads into space. The SRMs provide more lift capability at a cheaper cost to both the launch vehicle provider and the payload provider. In the long term, the result is a more cost-effective system. Explanation of the purpose and need for the Proposed Action and overall program is found in Section 2 of the FSEIS.

11-3 John Herrman

The FSEIS is an environmental document that supplements the analysis conducted in the 1998 FEIS. The supplemental analysis is required because of a change to the 1998 FEIS Proposed Action (Concept A/B) that was made subsequent to the signing of the ROD for that document. The FSEIS Proposed Action is the addition of larger SRMs for the Delta IV and Atlas V systems. The 1998 FEIS Proposed Action was carried forward to the DSEIS as the No-Action Alternative, with some minor changes. The Proposed Action in the 1998 FEIS would have allowed both Boeing and LMC to continue to develop and deploy their respective EELV systems. Subsequent to the ROD for the 1998 FEIS, some planning assumptions have resulted in updates to the FEIS Proposed Action as it carried forward to be the No-Action Alternative in the DSEIS. These revisions include a reduction in launch rates (from 534 to 472) over the 20-year planning program, increased water use for Atlas V vehicles, minor facilities modifications, and deletions of certain launch vehicle configurations. Sections 1 and 2 of this FSEIS provide a detailed discussion of the differences between the 1998 FEIS and this FSEIS. Also see response to comment 4-11.

Comment 12

Written Comments Received at Vandenberg AFB Public Meeting

12-1 John Herrman

Comment acknowledged.

12-2 John Herrmann

The commentor expressed concern about commercial LVCs complying with environmental and safety requirements for launch vehicle programs. The EELV contractors have a built-in incentive to ensure public safety and environmental stewardship. If their systems are not safe, then they will lose business to other competitors. They are required to ensure environmental stewardship under the auspices of the leases they have signed with the respective bases as the landlord. Additionally, LVCs are required to comply with applicable federal, state and local regulations under potential penalty of fines or imprisonment. See General Comment Response No. 1, Public Health and Safety. Agencies overseeing compliance with NEPA requirements for the EELV program are found in Sections 1 and 5.

12-3 John Herrmann

The commentor suggested an approach to ensuring that LVCs adhere to environmental stewardship responsibilities in a lease agreement, and suggests that private companies do not have an incentive to perform environmental stewardship. The specifics of the tenant-lease agreement for the LVC and Air Force for the EELV program and analysis of industry profit motives are beyond the scope of the FSEIS. The EELV contractors have signed contracts, leases, and licenses with the government to ensure public safety and environmental stewardship. Under the execution of these documents the government has insight into the contractors' activities and, where necessary, will ensure that the contractors fulfill these requirements.

12-4 Justin Ruhge

The commentor has suggested an approach to environmental impact analysis in general for the Proposed Action. This comment is similar to Comment 10-1; see response to this comment.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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Received

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

DEC 2 1 1999

Mr. Jonathan D. Farthing
Environmental Analysis Division
HQ AFCEE/ECA
3207 North Road
Brooks AFB, TX 78235-5363

Dear Mr. Farthing:

In accordance with the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the Environmental Protection Agency (EPA) has reviewed the Department of the Air Force's Draft Supplemental Environmental Impact Statement (EIS) for the Evolved Expendable Launch Vehicle Program. The proposed action is to allow the use of five strap-on solid rocket motors in the Atlas V lift vehicle and to allow the use of larger solid rocket motors on the Delta IV lift vehicle.

The 1998 Final EIS addressed the use of fewer strap-on solid rocket motors in the Atlas V lift vehicle and smaller solid rocket motors on the Delta IV lift vehicle. This document assesses environmental impacts of the newer configuration since it was not analyzed in the original document.

1-1 We believe that the EIS has addressed the environmental impacts of the proposed action. Therefore, EPA has no objection to the preferred alternative as discussed in the Draft Supplemental EIS. We have included some technical clarification items that we believe will improve the technical accuracy of the document.

We appreciate the opportunity to review the EIS on this project.

Sincerely,

Richard E. Sanderson
Director
Office of Federal Activities

Enclosure

Draft Supplemental EIS
Evolved Expendable Launch Vehicle Program

1-2 Page 3-9. A note to Table 3.10-2 defines µg/m³ as "milligrams per cubic meter." This obviously is incorrect. We recommend that you check the units and reported values for observed concentrations and regulatory threshold values.

1-3 Page 3-10, Table 3.10-4. The two values for ozone in 1996 seem to be incorrect. They appear to be reversed.

1-4 Page 3-13 to 3-14. Section on "Stratosphere." We suggest that the following two changes.

- two of the cited references are not included in the References section of this document (SEDEC, 1998, and Malina et al., 1997).

- use more standard definitions and descriptions of ODSs – take this information from the most recent (1998) Scientific Assessment of Ozone Depletion. The current definition in this document of ODSs (part of which reads "substances that contain the elements chlorine, bromine, fluorine, or nitrogen") is inadequate.

1-5 Page 3-13, top of page. Passages such as the following contain many errors and should be re-written using the ample material in commonly available sources (e.g., the 1998 Scientific Assessment of Ozone Depletion, or the EPA Stratospheric Protection web site (http://www.epa.gov/ozone)). We recommend that you not define new terms (e.g., "ground-based ODS") that stretch the well-established understanding of important terms used in scientific and policy discussions of stratospheric ozone depletion.

"In response to the threat of ground-based ODS to the stratospheric layer, the international community adopted the Montreal protocol [sic] (and subsequent amendments) to phase out the use of ground-based ODS in developed countries by 1999, and in undeveloped countries by 2010. In the United States, the ODS [sic] implements ODS regulations through the Clean Air Act (CAA) (1991) [sic] and subsequent amendments (Title 40 CFR 82, Protection of Stratospheric Ozone). However, because of the long residence times of ground-based CFC, ground-based ODS will continue to contribute more than 100,000 tons of chlorine annually into the stratosphere over the next century. Ground-based ODS is by far the largest contributor to ozone destruction. Because the stratosphere does exchanges [sic] mass with the troposphere (albeit at a relatively low rate), the residence time of a chlorine molecule in the stratosphere is on the order of a few years."

- "phase out the use of ground-based" – delete "the use of ground-based." "Ground-based" is a meaningless term from the point of view of international and domestic agreements to protect stratospheric ozone. Delete this term when it is applied to ODSs throughout the document. It is also not the "use" which has been phased out, but rather the production.

"by 1999" – delete this date as it is an oversimplification and either list all the various phase out dates or do not put any date. Halons, a class of potent ozone-depleting substances, were phased out in developed countries in 1994; CFCs and several other compounds were phased out in 1996. Similarly, take out "by 2010." The phase out schedule for developing countries is more complex.

"the ODS implements ODS regulations through the Clean Air Act (CAA) (1991) and subsequent amendments (Title 40 CFR 82...)." There are many inaccuracies in this sentence. We suggest it be rewritten to say "The United States Environmental Protection Agency (EPA) implements ODS regulations through Title VI of the Clean Air Act as Amended in 1990 (CAA)."

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

2

December 21, 1999

Jonathan D. Farthing, Chief
Environmental Analysis Division
HQ AFCEE/ECA
3207 North Road
Brooks AFB, Texas 78235-5363

Dear Mr. Farthing:

The Southeast Regional Office, Habitat Conservation Division of the National Marine Fisheries Service (NMFS) has reviewed the Draft Supplemental Environmental Impact Statement (SEIS), provided with your letter dated November 4, 1999, investigating the use of solid rocket motors on the Atlas V and Delta IV lift vehicles at Cape Canaveral Air Station in Brevard County, Florida.

The Draft SEIS does not make a determination on potential impacts to Essential Fish Habitat (EFH) as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Much of the aquatic habitat in and around Cape Canaveral Air Station is identified as EFH in the 1998 Amendment of the Fishery Management Plans for the South Atlantic Region. This Amendment was prepared by the South Atlantic Fishery Management Council as required by the 1996 amendment to the Magnuson-Stevens Fishery Conservation and Management Act. Categories of EFH in estuarine areas include: emergent wetlands, scrub/shrub mangroves, seagrasses, oyster reefs, shell banks, intertidal flats, palustrine-emergent and forested wetlands, aquatic beds, and the water column. In marine areas, EFH includes: live/hard bottoms, coral and coral reefs, artificial and manmade reefs, sargassum, and the water column.

2-1 Federal agencies which permit, fund, or undertake activities which may adversely impact EFH must undertake an EFH consultation with the NMFS. If the U.S. Air Force determines that the proposed action will not adversely impact EFH then no further consultation with the NMFS is required. The Air Force's determination of no adverse impact or a summary of EFH consultation should be provided in Appendix N of the SEIS. An EFH assessment must include: 1) a description of the proposed action, 2) an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species and major prey species, 3) the Federal agency's views regarding the effects of the action on EFH, and, 4) proposed mitigation, if applicable. Additional information regarding EFH in the South Atlantic Region can be found at the following Internet site: http://www.safmc.noaa.gov/.

If we can be of further assistance, please advise. Related comments, questions or correspondence should be directed to Mr. David N. Dale in St. Petersburg, Florida. He may be contacted at 727/570-5311 or at the letterhead address above.

Sincerely,

for Andreas Mager, Jr.
Assistant Regional Administrator
Habitat Conservation Division

cc:
F/SER4
F/SER43
F/SER3

received [illegible]

Santa Barbara County
Air Pollution Control District

3

December [illegible], 1999

Mr. Jonathan D. Farthing, Chief
Environmental Analysis Division
HQ AFCEE/ECA
3207 North Road
Brooks Air Force Base, TX 78235-5363

RE: USAF Evolved Expendable Launch Vehicle (EELV) Program
Draft Supplemental Environmental Impact Statement (SEIS) - November, 1999.

Dear Mr. Farthing:

The Santa Barbara County Air Pollution Control District (SBCAPCD) thanks Lt. Col. Gale Brown and her team for meeting with us on Dec. 14, 1999. We appreciated the opportunity to discuss our comments on the air quality impact-related portions of the SEIS for the above project as it relates to Santa Barbara County.

The following concerns were discussed at the meeting:

3-1 • The SEIS modeling analysis (Aerospace Corp.) predicts that the health-based, 24-hr California Ambient Air Quality Standard (CAAQS) for PM_{10} will be exceeded. This is considered a significant air quality impact. The 1998 FEIS acknowledges that, "the REEDM-predicted concentrations are screening concentrations only; a systematic search for worst-case meteorology was not conducted". In addition, the prediction could change by a factor of 2 or 3 if the cloud characteristics of the new vehicles are similar to the current generation of Titan or Atlas vehicles. The Aerospace Corp. representatives confirmed this.
3-2 Since the Rocket Exhaust Effluent Diffusion (REEDM) model appears to be sensitive to inversion height and strength, please clarify the inversion criteria used in the model. We also request a copy of the REEDM manual.

3-3 • The SEIS shows that HCl emissions will be significant and could cause significant public health impacts, especially if an explosion occurs on the launch pad. Please provide a copy of the launch criteria and emergency planning procedures used to mitigate public health and safety impacts to the population on VAFB as well as the nearby community of Lompoc.

3-4 Thank you for educating us on the adverse, but insignificant, global impact of the stratospheric ozone-depleting potential of this project. The SEIS should address other cumulative long-term effects of the EELV, such as any increase in acid fog and acid rain.

We look forward to receiving the requested materials and the Final SEIS.

Sincerely,

David Romano,
Air Quality Engineer

cc: Lt. Col. Gale Brown, Chief, System Engineering Div., EELV Program Office
[illegible]
[illegible], APCD
[illegible]
Project File (VAFB EELV)
[illegible] File
[illegible] File

Douglas W. Allard, Air Pollution Control Officer
26 Castilian Drive B-23, Goleta, CA 93117 [illegible]

[illegible]

CITY OF LOMPOC

VALLEY OF FLOWERS

4

December 21, 1999

Mr. Jonathan D. Farthing
Chief, Environmental Analysis Division,
HQ AFCEE/ECA
3207 North Road
Brooks AFB, Texas 78235-5363

Dear Mr. Farthing:

Thank you for the opportunity to comment on the Draft Supplemental Environmental Impact Statement (DSEIS) for the Evolved Expendable Launch Vehicle (EELV) Program.

We understand that the difference between the approved Final Environmental Impact Statement (FEIS) for the EELV program and the proposed changes, which required the preparation of this DSEIS, is an increase in the number of launches and the size of the rockets to be used. These changes to the approved EELV program are being proposed by both Lockheed Martin and Boeing. Boeing proposes to attach 2-4 larger solid rocket motors (SRMs) to their previously planned Delta rockets, which will be launched from SLC 6. Lockheed proposes to use 5 strap-on solid rocket motors (SRMs) in addition to previously planned rocket fuel for Atlas launches from SLC 3. The launching of these rockets is proposed to take place from SLC 3 and SLC 6 on south Vandenberg Air Force Base (VAFB). EELV launches using SRMs are currently only approved for use by Boeing at the SLC 6 launch facility, which is further from the Lompoc Valley than SLC 3.

You may not be aware that the City of Lompoc is participating in an interagency effort to examine potential causes for a reported increase in respiratory disease in Lompoc. This inquiry is being undertaken through a coordinated effort involving the US EPA, various State of California agencies, Santa Barbara County and the City of Lompoc. Several sources of airborne pollutants in the Lompoc Valley, including launch emissions, are being evaluated to determine if they could be contributing to respiratory disease.

Details regarding the reported increases in respiratory disease in Lompoc can be found in the report, Illness Indicators in Lompoc, California, June 1998. This report was prepared by the Pesticide and Environmental Toxicology Section of the Office of Environmental Health Hazard Assessment, of the California Environmental Protection Agency. The report states that the incidence rates of lung and bronchus cancers are significantly elevated in Lompoc, as compared to expected numbers based on regional incidence rates. In addition, elevated proportions of hospital discharges for bronchitis, asthma, and perinatal respiratory disease, relative to all non-birth and non-birth related hospital discharges, were found.

CITY HALL, 100 CIVIC CENTER PLAZA, P.O. BOX 8001, LOMPOC, CA 93438-8001
(805) 736-1261; FAX (805) 736-5347

The City's concerns and questions regarding the proposed changes in the EELV program are detailed in the following sections of this letter. First the City's concerns are identified, along with factors which we would like to have addressed. In addition, a list of questions has been detailed. We believe that the answers to these questions will assist decision makers in evaluating this proposal and in ensuring the health and welfare of Lompoc Valley residents.

1. HEALTH AND SAFETY

Our primary concern is the long-term health and safety of Lompoc's citizens and the assurance of adequate emergency response planning. Because HCL is a known respiratory irritant and HCL exposure has been reported to cause chronic bronchitis, we are very concerned about the potential effects on Lompoc's population of the increase in the size and number and proximity of HCL clouds which would result from the proposed revisions to the approved EELV program.

We understand that HCL gas is classified as an extremely hazardous substance and is a severe pulmonary, skin and eye irritant, potentially causing pulmonary edema and death. Victims can collapse, lose consciousness or experience convulsions. HCL is reported to be corrosive to eyes, skin, mucous membranes, respiratory and gastroesophageal tracts and will contaminate clothing. Chronic or prolonged exposure may impair breathing, or cause chronic bronchitis or dermatitis.

4-1 Review of the DSEIS shows that no analysis, mapping or modeling of the existing or increased number and size of HCL toxic clouds specific to this proposal and its launches from VAFB SLC 3 and SLC 6 is presented. Localized weather patterns, seasonal variations, topography and meteorology should be taken into account in determining the effect of HCL deposition on the Lompoc Valley. The DSEIS specifically states that the worst case scenario was not evaluated, so the potential effect on the citizens of the Lompoc Valley is unclear. It is important to clearly identify the characteristics of HCL transport and deposition to evaluate acute and chronic exposure of Lompoc Valley residents, as well as identifying the potential impacts of HCL deposition on crops. Emergency response by VAFB and notification and coordination with local authorities is not addressed in the DSEIS. Therefore, we believe that the draft SEIS, as presented, is inadequate to allow decision makers to determine the potential long and short term impacts of the proposal on the citizens of the Lompoc Valley.

2. AIR AND WATER QUALITY

We are also concerned about potential impacts of the proposed use of solid rocket motors on overall air and water quality in Santa Barbara County.

The DSEIS states that hydrochloric acid gas in the exhaust plume would be carried away from the launch site and that launches of large SRMs during light rainfall or slow wind conditions can cause deposition of various concentrations of acid which could cause adverse effects to surface water and biota. Dry weather launches and other weather conditions have been modeled to indicate that a maximum of 10,100 milligrams per square meter of hydrochloric acid would be deposited as particles about 1,000 meters from the launch.

The DSEIS argues that the alkalinity of the salty ocean air would neutralize the effects of HCL when it is deposited on the ground or in fresh water. No monitoring of the impact of HCL deposition on vegetation or water bodies such as Bear Creek or Canada Honda Creek has been conducted, to our knowledge, or is proposed after launches at SLC 3 or 6 to determine whether the HCL actually is neutralized and if it is, how long this process takes. No evidence of survey or monitoring of the short term effects of acid deposition on streams is included in the document. It is noted that several
4-2 aquatic or amphibious endangered species are present in and around Canada Honda Creek and that without specific data, the effects of the proposed launches using solid rocket motors on these species cannot be determined.

3. NOISE

Information in this section refers to launch rates of the proposed rockets with SRMs of approximately 1 per month. Noise levels in the Lompoc Valley from the proposed launch activity are estimated to reach 80-85 dba, with estimated sound pressure levels of 100 - 105 dba.

Because noise measurements and data regarding sonic booms are not available for launches which
4-3 utilize solid rocket motors, monitoring for noise and vibration impacts to humans and wildlife resources should be conducted to assist in the ongoing mitigation of impacts.

4. BIOLOGICAL RESOURCES

Atlas at SLC 3

The DSEIS states that SRMs were used in the mid to late 60's at SLC 3, but that more sensitive plant species may have colonized the area since the end of that program. The DSEIS states that vegetation would "adjust" to the reintroduction of SRMs by the elimination of acid sensitive species. How can a determination be made that the impact of the proposed increase in HCL deposition is not
4-4 significant, if plant species which are sensitive to acid will be required to "adjust" by being eliminated? No evidence was presented that biological surveys of the existing plant types in the impacted area have been conducted or that studies of the impact of HCL on area plants have been done. No identification of the plants expected to be eliminated by the proposed program is presented.

The report states that once acid sensitive species are eliminated, only temporary impacts to the remaining vegetation within 800 meters would result from the increased use of SRMs at this site.
4-5 This determination is based on monitoring which was conducted at Cape Canaveral. Therefore, impacts on localized species, such as Burton Mesa Chaparral, and impacts of local topography and meteorological conditions specific to VAFB and the Lompoc Valley have not been adequately evaluated.

Even if it is shown that a given plant population will recover within one growing season as predicted,
4-6 this information must be compared to the frequency and timing of launches from SLC 3 and SLC 6. If more than one launch is proposed to occur within a single growing season, the plant population may not be able to regenerate. If this is the case, impacts may be substantial, in that plant populations may not regenerate after the conclusion of this 20 year program.

The increased HCL deposition on monarch butterfly habitat and wildlife which could be affected by
4-7 launches from SLC 3 was not evaluated. It was noted that HCL deposition could affect monarchs in major overwintering area from Nov. - Feb. However, no modeling of the amount of deposition at the overwintering area or discussion of impacts of acid on butterflies is presented.

Delta at SLC 6

According to the DSEIS, the impacts of the Delta program are the same as those for the Atlas program, except that a higher peak HCL deposition was modeled, resulting in depositions of 10,100 mg/m2 within 1000 meters. Concentrations at VAFB are expected to be 10% higher than modeled launches at Cape Canaveral, which were determined to cause reversible impacts on vegetation. Because no vegetation monitoring of launch impacts at VAFB has been conducted, this assumption
4-8 derived from Cape Canaveral monitoring was applied to identify projected impacts at VAFB. No evaluation of the proposed 10% higher HCL concentrations expected at VAFB has been made. This should be identified and addressed in the SEIS.

The proposed increases in HCL deposition could significantly adversely impact the shallow Canada Honda Creek and the tidewater goby, unarmored threespine stickleback and red legged frog which are found in there. The evaluation of impacts in this case is based on monitoring of similar launch
4-9 vehicles at Cape Canaveral which found that the HCL cloud was generally limited to the launch pad. This analysis does not account for localized meteorology and topography at VAFB. The monitoring at Cape Canaveral found that the HCL emitted was not found to affect the pH of nearby surface waters on a long term basis. This does not evaluate, however, the short term impacts of pH changes
4-10 due to acid deposition on the endangered species found at VAFB. While it is argued that acid deposition will be neutralized by the alkalinity of the sea air, no data or technical support for this theory is given.

5. ALTERNATIVES

The required alternatives analysis under NEPA has not been provided. No alternative, other than the no action alternative has been identified or evaluated. It is not enough to identify the alternatives
4-11 discussed in the previous EIS as alternatives to the current proposal. This is because the previously identified alternatives do not identify a reasonable range of alternatives which address the agency's objectives (e.g. purpose and need) in this specific case. The proposal under consideration, the desire of Boeing and Lockheed for a middle lift capability and reduced operating costs, was not evaluated in the original EIS for the EELV. It should be noted that feasible alternatives may be considered reasonable, even if they are outside the legal jurisdiction of the lead agency.

Therefore, the City requests that a full analysis of alternatives to the proposed action, as required under NEPA, be prepared. The preferred alternative, as well as the environmentally preferable alternative must be identified. It is important to determine if there are other alternatives which would increase rocket booster power which may have fewer potential impacts to human health and safety, air and water quality and biological resources. These may include methods which incorporate technology developed after the 1960's which may have fewer impacts on the human and natural environment. This will allow decision makers to compare the impacts of the proposed changes to the EELV program against reasonable alternatives to the proposal.

4. QUESTIONS AND COMMENTS

The following questions and comments are intended to augment the previously identified concerns and provide specifics regarding the issues that we believe should be addressed in the SEIS.

4-12 1. In the DSEIS, it specifically states on page 4-46 that the worst-case meteorology was not used to determine potential impacts to human life. The impacts from HCL emissions were discussed in the Cape Canaveral Section, but were not fully evaluated in the context of VAFB and the Lompoc Valley, only noting that there would be "less than a 5% difference" for VAFB. We believe that this information is incomplete for purposes of decision making and that information on the worst-case meteorology is not unavailable and should be evaluated.

4-13 2. While meteorological data is evaluated prior to a launch to determine if it should be canceled, rescheduled or proceed as planned, is meteorological data currently evaluated or proposed to be evaluated after each launch, to determine the size, location and characteristics of the HCL cloud, including its movement and concentrations? If yes, please provide more details regarding this process of evaluation. If not, modeling and monitoring should be conducted to adequately determine the health effects of HCL deposition on the residents and crops in the Lompoc Valley.

4-14 3. Has modeling been used or monitoring conducted to determine when and in what concentrations HCL emissions reach Lompoc? If actual monitoring of detectible HCL emissions in Lompoc been performed after a launch, please provide the results of the monitoring. We request that a monitoring program be designed and implemented to quantify the amounts of HCL reaching Lompoc in various meteorological scenarios.

4-15 4. Since Tier I values have not been recommended for hydrazine, what method has been used to ensure that risks from this substance have accurately been evaluated. Also, since HCL is an identified health concern, why are Tier 1 values not used as the comparison values in Tables 4.7-3 and 4.7-4? Please provide Tier 1 values for comparison against the projected HCL emissions to determine the expected effect on humans from chronic (cumulative) exposure.

4-16 5. We also understand that HCL is incompatible with metals, producing highly flammable hydrogen which may form an explosive mixture with air. It can also react with oxidizers, generating toxic chlorine gas; with cyanides or sulfides producing toxic hydrogen cyanide or hydrogen sulfide gas; and with formaldehyde forming bischloromethyl ether, an OSHA regulated carcinogen. What is the likelihood of these chemical reactions occurring either at launch or during dispersal of an HCL cloud?

4-17 6. How long does it take for HCL to dissipate, or settle to a point where it is no longer expected to be a health threat? Does this time vary with changing meteorology or humidity? What are the dispersal patterns of this gas? If necessary, what steps could be taken to avoid exposure, on an individual or citywide basis, should a hazardous condition be determined to exist?

4-18 7. Given that the prevailing low level wind pattern is from VAFB toward Lompoc, what are the referenced "regional and on-station safety programs" in effect to ensure the long and short term health of the 42,000 Lompoc residents? Do these programs address acute and chronic exposure of humans to HCL gas? What emergency response plans and measures are in place to address the hazards from HCL clouds? How will Lompoc be notified of HCL cloud formation? Will the Lompoc Fire and/or Police be notified if a hazardous condition is identified or projected? What is the expected lead time for information regarding a projected threat? How will the safety of Lompoc Valley residents at area homes, farms and in urban centers be ensured in case of the formation of a large HCL ground cloud or an anomaly?

4-19 8. It is stated that the chance of an anomaly is extremely low. What is the basis for this determination? How does the anomaly scenario change with the addition of the solid rocket motors? Does this make an anomaly more or less likely?

4-20 9. In the scenario of destruct at T-90 seconds, is there any indication that the debris area of 10 miles would include areas north of the launch site, including Lompoc Valley ranches, homes and farms? Has modeling been done on this? How much greater is this potential from the proposed changes to the EELV program than from the approved program and existing launch patterns. It is assumed that because this information is identified and analyzed in the DSEIS that this 10 mile radius is unique to the use of the older technology SRMs, is this the case?

4-21 10. Analysis of a Delta destruct at T+30 seconds shows debris in a 2 mile by 1 mile area. No information is given on T+90. What is the projected area and location of this debris deposition?

4-22 11. The DSEIS projects that plants "impacted" by HCL deposition at launches will grow back within one growing season. However, this information must be compared to the frequency and timing of launches from SLC 3 and 6 in order to determine the impact. What is the impact of multiple launches from one site on the ability of the plants to regenerate over the 20 year program period?

4-23 12. Concentrations of HCL deposition at VAFB are expected to be 10% higher than modeled launches at Cape Canaveral, which were determined to cause reversible impacts on vegetation. Because no vegetation monitoring of launch impacts at VAFB has been conducted, this assumption derived from Cape Canaveral monitoring was applied to identify projected impacts at VAFB. The impact of the proposed 10% higher HCL concentrations expected at VAFB should be identified and addressed in the SEIS.

4-24 13. While it is stated that potential impacts to biological resources are expected from dropping of booster and payload fairings in the ocean, it is unclear how and where in the document this impact is addressed.

4-25 14. Monitoring and reporting are proposed as a method of avoiding impacts to biological resources. What process will be used to ensure that the program will change if adverse impacts are identified through monitoring?

4-26 15. Impacts to wildlife from HCL deposition from Atlas launches at VAFB do not appear to have been addressed in the DSEIS. Increased harassment or death of wildlife, including endangered

species, by the proposed changes to the EELV program are a concern for the City. The City regularly accounts for and mitigates for impacts to endangered species in our area. Substantial impacts to these species from commercial launch activity would undermine the efforts of government and citizens to protect these species.

4-27 16. The DSEIS does not evaluate the short term impacts of pH changes due to HCL deposition on the endangered species found at VAFB. This evaluation should be made and specifics provided on the potential impacts to local species, including threatened and endangered species.

4-28 17. Biological surveys of the existing plant types in the area of SLC 3 and 6 should be conducted and the effect of HCL on identified plants determined. A list of the plants expected to be eliminated by the proposed program should be presented.

4-29 18. Page 4-139 of the DSEIS notes that there is a lack of biological data for SLC 3, requiring evaluation of data from other areas/sites. A monitoring and data collection program should be designed to provide information on the impacts of launch activity on the vegetation and wildlife resources in the area of SLC 3 and 6.

As we have stated, our concerns focus around the localized impacts to the Lompoc Valley in terms of air and water quality, impacts to biological resources and the health and safety of the public. We urge that adequate studies, modeling and monitoring be provided to clearly define and evaluate impacts on Lompoc's residents. If public health and safety in a worst case meteorological condition during any launch scenario, including explosion, cannot be ensured, this proposal, made by private companies to ensure affordability of company operations, should be denied.

Sincerely,

Dick DeWees,
Mayor, City of Lompoc

cc: US Senator Barbara Boxer
US Senator Diane Feinstein
US Representative Lois Capps
Governor Gray Davis
CA State Senator Jack O'Connell
CA State Assembly Member Abel Maldonado
CA State Assembly Member Hannah Beth Jackson

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Thiokol Propulsion
From Cordant Technologies

5A

December 23, 1999
3600-CY99-L031

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Mr. Farthing:

5A-1 The draft of the EELV Supplemental Environmental Impact Statement (SEIS) contains many gross errors and represents a lack of understanding of the real environmental impacts relative to ozone destruction by rocket exhaust in the earth's stratosphere. The SEIS clearly attempts to make solid rockets appear far more damaging to the stratospheric ozone layer than real scientific data and analysis indicates they really are. This document continues to defend the basic LO_2/RP-1 core vehicle as a no-impact vehicle in spite of the preponderance of scientific evidence that has been gathered over the last several years. Unfortunately, this is a good example of what happens when a request is made to the original author to add or supplement a document that was grossly in error in the first place. The original 1998 EIS for the all-liquid EELV contains a statement, "Under Concept A [Atlas V with no solid rocket motors], launches would produce no estimated emissions of ODSs, and therefore, would not contribute to any degradation of the stratospheric ozone layer." (EELV SEIS), p. S-7). That statement was contrary to the conclusions in the World Meteorological Organization's (WMO) report to the United Nations Environmental Program for assessment of stratospheric ozone in 1991 and subsequent years.

What is most disturbing about this document is that it totally ignores real scientific measurements and data collected from actual fly throughs of stratospheric rocket exhaust plumes over the past few years. This data was collected under the Rocket Impact on Stratospheric Ozone (RISO) Program and Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT) Program; these programs involved Air Force, NASA, NOAA, Aerospace Corporation, Industry, and University participation. The initial RISO program was funded by the Air Force Titan IV program office because of the concerns raised about solid rocket exhaust impacts on stratospheric ozone; the Titan IV is a 100% solid rocket boosted space launch vehicle. The Titan IV data was supplemented with data from NASA's Space Shuttle, which uses significantly larger SRMs that provide nearly 80% of the boost thrust for the Shuttle. The data obtained from both of these vehicles was comparable and indicated that the ozone destruction problem over the launch site was not nearly as severe as some earlier analytical models had predicted. Even though the RISO program was totally focused on SRMs, data was obtained from a Delta II launch as a target of opportunity in the fall of 1996 when a planned fly through of a Shuttle launch was scrubbed. The data obtained from the Delta II fly through clearly indicated that there may well be a significant contribution to ozone destruction from the exhaust of the LO_2/RP-1 core vehicle. The amount of ozone destroyed by the Delta II vehicle could not be explained by chlorine chemistry alone from the three solid propellant graphite epoxy motors (GEMs). This data

was in obvious conflict with the original EIS for the EELV and it appears that it was withheld from peer review and public release for that reason. Since that time, data has been obtained from another Delta II flight that confirms the accuracy of the original 1996 Delta II data and even more recently, data has been obtained from two Atlas IIAS flights which indicates even more ozone destruction than the Delta II. During stratospheric flight, the Atlas IIAS uses two Castor IVA SRMs that are smaller than the GEMs on the Delta II and the Atlas IIAS also has a larger LO_2/RP-1 booster engine than the Delta II. Ignoring the implications of this data in preparation of the draft SEIS for the EELV does not appear to be an oversight and is technically irresponsible.

Over the years the Russians have released information to the public press and media that has implied that launch vehicles and solid rockets, in particular, are a major contributor to global stratospheric ozone destruction. The American Institute of Aeronautics and Astronautics (AIAA) conducted a workshop on this subject in conjunction with the 35th Joint Propulsion Conference held in Los Angeles in June 1999; the proceedings of this workshop were made available to all those who attended. In addition, the International Astronautics Academy (IAA) requested the Advanced Propulsion Working Group (APWG) of the IAA to examine this problem and report its findings at the 50th International Astronautical Federation (IAF) Congress held in Amsterdam this past fall. Members of the IAA/APWG met in Paris in March 1999 and presented their findings at the IAF Congress in Amsterdam last October as requested by the IAA. The findings concluded that all rockets have some minor impact on global and local ozone destruction and that solid and liquid rockets are comparable.

A totally ill-founded Russian claim concerning ozone destruction from launch vehicles this past year appeared on the CNN website; the Russians claimed that 35% of the ozone being destroyed in the atmosphere today is due to rocket launches. I requested Dr. Bennett of Thiokol Propulsion to forward this misinformation to the U.S. Environmental Protection Agency (EPA) for a response. The EPA's response to Dr. Bennett confirmed that the Russian information was erroneous and furthermore, the EPA claimed that there is no real difference between liquid and solid rockets relative to stratospheric ozone depletion; this EPA memo was included as Appendix II to the IAF paper that I presented in Amsterdam last fall. The conclusions of the EPA were in total agreement with the recognized international experts on rocket propulsion for the IAA/APWG, and the international experts on atmospheric chemistry from the WMO. No mention of the IAA activities, WMO report or the EPA's assessment of this issue was included in the SEIS.

I have asked Dr. Robert Bennett from Thiokol Propulsion to respond to the draft SEIS and his comments are attached. As you can observe in his response, he has found many gross errors that need to be corrected but more importantly, major errors of omission need to be corrected. These errors are first, the failure to recognize the data that exists on this subject from the RISO and ACCENT programs and second, the failure to acknowledge the conclusions that have been drawn by the RISO/ACCENT investigators and the international experts from the IAA, WMO and EPA. The RISO/ACCENT data along with the conclusions from these organizations is clearly in conflict with this draft SEIS relative to the assessment of the impact of both SRMs and LO_2/RP-1 engines on stratospheric ozone destruction. The draft SEIS as currently written is in gross error and is technically irresponsible relative to this issue.

Allan J. McDonald

Notes on the EELV Supplemental Environmental Impact Statement 5B

Dr. Robert R. Bennett

Thiokol Propulsion

The following notes were made after reading the draft of the EELV Supplemental Environmental Impact Statement (SEIS). The notes are by no means comprehensive, but point out some of the particular problems with the document. Since they are areas in which I have knowledge and experience, I focused on the Lower and Upper Atmosphere Air Quality sections. I found the lower atmosphere sections to be consistent with what I know of the recent literature and changes that have been made to the REEDM code used to model rocket exhaust cloud rise and dispersion. Although it has some drawbacks, REEDM is the only operational code approved by the Air Force for use at the test ranges. It has undergone significant revisions and improvements in recent years.

The discussion of upper atmosphere in the EELV SEIS is problematic. The information presented is outdated in many instances and simply wrong in others. Generally, the stratospheric impact of solid rocket motors is overstated, while the impact of LO_2/RP-1 motors is understated. The most glaring errors and inconsistencies are in the area of transient local launch site stratospheric ozone impacts. Early model that predicted large local impacts on column ozone concentrations for several hours, as well as other models that show extremely rapid (one to a few minutes) plume dispersal for smaller rockets (Atlas and Delta vs. Titan and Shuttle), are both cited. Both have been shown in recent years to be in error by the data collected by the Rocket Impact on Stratospheric Ozone (RISO) and Atmospheric Chemistry of Combustion Emissions near the Tropopause (ACCENT) Programs. Unfortunately, very little of the data from these programs was cited, and that which was, was cited in error.

There have now been measurements made that show the short-term impact of launch vehicles on the stratosphere. Ozone depletion within the exhaust clouds of the Atlas, Delta, Titan and Space Shuttle launch vehicles for 1-2 hours after a launch has been shown. Despite the ozone destruction within the exhaust cloud, ground level UV levels are not raised because of the rapid horizontal shearing of the cloud. However, chlorine chemistry from solid rocket motors alone is not sufficient to explain the ozone loss measured in the Delta and Atlas vehicles. A second mechanism is therefore implied. Soot or other reactive species from the incomplete combustion products of LO_2/RP-1 motors remain a potential source of this added ozone destruction. In light of the current data, it will simply not do to ignore such a possibility. Specific sections of text with which I take exception, and the reasons for doing so, are given below in the order in which they appear.

SB-1 p. 3-12: 2nd paragraph in sec. 3.11.2: The statement is made that

> "ODS [ozone depleting substances] are generally substances that contain the elements chlorine, bromine, fluorine, or nitrogen ..."

Comment: The presence of fluorine and nitrogen are not generally sufficient for a compound to be classified as an ODS. In the stratosphere, fluorine atoms are difficult to free from a compound. When they are, they form HF relatively quickly. HF is quite stable, even in the stratosphere, and is not likely to release its fluorine to an ozone depletion cycle. While nitrogen oxide can react with ozone, nitrogen compounds in general are not ODS's. The bulk of the atmosphere is molecular nitrogen, which is certainly not an ODS. In fact, there are no nitrogen containing compounds listed as either Class I or Class II ODSs in the lists on the EPA internet site (see www.epa.gov/Ozone/ods.html).

SB-2 p. 3-12: 1st paragraph in sec. 3.11.2 the phrase is used: "atomic chlorine (or bromine) molecule".

Comment: What is this? It is correct to say "atomic chlorine" (Cl) or "molecular chlorine" (Cl_2), rather than the phrase used.

SB-3 p. 3-12: 2nd paragraph in sec. 3.11.2 last sentence

> "a single chlorine molecule can interact with many ozone molecules".

Comment: Strictly speaking, chlorine molecules don't interact with ozone at all. They must first be broken down to chlorine atoms. Author should replace 'molecule' with 'atom'.

SB-4 p. 3-13: 1st paragraph, last sentence. Again, molecule seems to be confused with atom.

> "...the residence time of a chlorine molecule in the stratosphere is on the order of a few years."

Comment: This is incorrect. A chlorine molecule lasts only a few minutes in the stratosphere during the daytime. Replace "molecule" with "atom", and it is correct, so long as one understands that the chlorine atom may be in a variety of compounds during its stratospheric lifetime.

SB-8 p. 3-13: 1st paragraph, and throughout the document: the use of the term ODS is of some concern. The statement is made in this paragraph that:

> "The Air Force has phased out the use of ground-based ODS in its launch activities, which includes manufacturing, assembling and launching of the EELV program lift vehicles. However launch vehicle rocket exhaust continues to contribute to ODS."

Comment: It is important to distinguish here between ozone depleting substances that are banned by the Montreal Protocol, and those that are not. In the discussion, there seems to be no distinction made between ODS's that are listed as such by the Montreal Protocol, and those compounds that can potentially react with ozone, but are not on the Montreal Protocol phase-out list. It is my understanding that the ODS's that the Air Force has phased out are those listed by the Montreal Protocol, and not any compound that could conceivably react with ozone. Rocket exhaust does not contain any of the compounds listed as ODS's by the Montreal Protocol. If one is going to specifically point to HCl and Cl as ODS's, even though they are not on the Montreal Protocol phase-out list, then one should also point to NOx, HOx, and and alumina from solid and/or liquid rocket motors as ODS's. It would be better if none of these species were referred to as ODS's, since that term is generally understood to be substances listed under the Montreal Protocol.

A discussion of ODS usage is made in the original EELV FEIS. The references to ODS's in that document appear to be those substances classified as such by the Montreal Protocol.

The EELV FEIS states:

> "No Class I ozone-depleting substances (ODSs) would be utilized under the Proposed Action; the use of Class II ODSs would be minimized or eliminated."

In this case it is clear what classes of compounds are being referenced. With the Supplemental EIS, which uses the term ODS rather generically, the reader is left to assume (or not) that the compound referred to as an ODS is on the Montreal Protocol list.

> The EELV FEIS also states: "Under Concept A, launches would produce no estimated emissions of ODSs, and therefore would not contribute to any degradation of the stratospheric ozone layer." (EELV FEIS, p. 5-7)

Concept A refers to the original Atlas V rocket, which was to use no solid rocket motors. If the assumption is made here, as appears to be the case with the Supplemental EIS, that an ODS is any substance that could react with ozone, then the preceding EIS statement is false. Liquid oxygen/liquid kerosene engines can produce compounds that react with ozone, such as NOx, HOx and soot, and hence under the implied definition of the Supplemental EIS would be releasing ODSs.

5B-6 p. 3-13, 3[rd] paragraph, 1[st] sentence:

Comment: ClO is listed as a compound injected directly into the stratosphere by solid rocket propelled lift vehicles. While this compound is formed during subsequent reactions of chlorine atoms with ozone, it is not likely that it is formed directly by solid rocket combustion.

p. 3-13, 3[rd] paragraph, 1[st] sentence: the statement is made that:

> "Solid rocket-propelled lift vehicles inject ... nitrogen compounds (NO and N_2) ... directly into the stratosphere."

Comment: While this statement regarding NO may be true, it is somewhat misleading when compared with the following statement in the original EELV Final Environmental Impact Statement:

5B-7

> "Under Concept A [the Lockheed Martin concept of LO_2/kerosene engines with no solid strap-ons], launches would produce no estimated emissions to the atmosphere of any ODSs, and therefore would not contribute to any degradation of the stratospheric ozone layer."

The above statement is reflected in Table 4.11-6 in the FEIS, which shows zero NOx emissions in the stratosphere (above 49,000 ft).

While they are not formed to a significant level in the combustion chamber of rockets (<0.1% - see Table 1 below), nitrogen oxides can be formed in the exhaust plumes of solid rocket motors as a result of afterburning of the fuel-rich exhaust. They can also be formed via a very similar mechanism in the exhaust plumes of liquid rocket motors, including those fueled by LO_2/LH_2 and LO_2/RP-1. Thus it is misleading to specifically point to the SRMs as producing a potentially ozone reactive compound such as NO, without mentioning that the liquid core engines of both EELV vehicles could produce similar amounts of the same compound. That the liquid engines do produce NOx is shown in Table 4.11-2 in the draft Supplemental EIS, where the Atlas vehicles without SRMs (Atlas V 300/400 and Heavy) have NOx emissions. This table suggests that while the NOx emissions of the liquid and solid rockets are similar in the troposphere, the solid rocket motor NOx emissions are somewhat greater in the stratosphere. The reason for this is not discussed. It should be noted that all of the data shown here are theoretical calculations and not based on experimental data, although there may be some forthcoming from the ACCENT program.

A second point is the question of why molecular nitrogen is listed as an exhaust product in this section. The list is by no means comprehensive (water, carbon monoxide and carbon dioxide specifically are omitted). The only other compounds listed here besides molecular nitrogen are those that might influence stratospheric ozone levels. As a result, one might infer that molecular nitrogen emissions could contribute to ozone destruction in some way. Such a conclusion would be incorrect, so why even list molecular nitrogen in this sentence?

p. 3-13, 3[rd] paragraph, 2[nd] sentence:

> "Unlike CFCs, rocket exhaust products have stratospheric lifetimes on the order of a few years, depending on the altitude."

5B-8 **Comment:** This is not strictly true for the aluminum oxide. Solid particles do not necessarily follow the same circulation patterns as gases. The settling rate of particles down through the atmosphere is dependent on their density and size. The particle size measurements made by the RISO and ACCENT programs have shown that the bulk of the aluminum oxide is sufficiently large that it will settle out of the stratosphere in much less than a year.

p. 3-13, 4[th] paragraph, 2[nd] sentence:

> "However the effect of the afterburn as the plume cools can convert a substantial amount of HCl (21 to 65 percent, depending on altitude) to free chlorine (Cl and Cl_2) that is immediately available for destroying ozone..."

5B-9 **Comment:** This is not quite accurate. Cl_2 is not "immediately available for destroying ozone," but first must be photolyzed to free chlorine atoms. If sunlight is unavailable (as in a nighttime launch), the molecular chlorine will not break down into atomic chlorine and thus will not destroy ozone. It should

also be noted that by far the bulk of chlorine released from HCl during the afterburning process is molecular (Cl_2) rather than atomic (Cl) chlorine.

p. 3-13, 5[th] paragraph, 1[st] sentence:

> "aerosols could also assist in the destruction of ozone by ... (2) providing a surface that promotes the photolysis of CFC, thus freeing chlorine."

5B-10 Comment: One correction and two caveats should be made on this point. The correction is that to my knowledge, the experiments that were conducted on the release of chlorine from CFCs interacting with alumina did not involve photolysis (cleavage by light). The alumina simply acted as a catalyst in the chemical breakdown of the CFC. The first caveat is that the experimental data that showed the potential for CFC destruction on alumina was not obtained from alumina produced in a solid rocket motor. Catalytic activity is strongly dependent on the nature of the surface of the catalyst. Alumina produced by the combustion of solid rocket propellant may well have a very different catalytic activity than pure laboratory alumina. Second, if this sort of reaction does occur in the atmosphere, it will also likely occur in the troposphere. Since more rocket exhaust alumina is deposited into the troposphere than into the stratosphere, and a CFC molecule destroyed in the troposphere will never reach the stratosphere to participate in ozone destruction, the net effect of this process could be to result in less overall stratospheric ozone destruction.

5B-11 p. 3-13, 5[th] paragraph, 2[nd] sentence:

> "The nitrogen compounds also come into play by interacting with reservoir chlorine compounds to free chlorine."

Comment: This statement is true in part, but again misleading since the large majority of the nitrogen from SRMs is in the form of N_2, which does not enter into the ozone depletion cycle in any fashion. Since N_2 is included on the list of nitrogen compounds in the previous paragraph, and since the above sentence does not detail which nitrogen compounds "come into play," the implication is that N_2 plays a role in ozone destruction.

The fact that this whole discussion of the role of nitrogen chemistry was omitted from the original EELV EIS, and is now only added in discussing the impacts of SRMs, could also mislead the reader into thinking that the core engines play no role in nitrogen/ozone chemistry. The core engines may also produce nitrogen oxides as a result of afterburning, so any discussion of the interaction of nitrogen oxides and ozone should include both solid and liquid rockets.

p. 3-13, 5[th] paragraph, last sentence:

> "These effects [effects of aerosols on ozone destruction] are likely to have more impact in the far field, when the plume has cooled and dispersed."

5B-12 Comment: This statement is not correct. The effects of the alumina or any heterogeneous surface are dependent on the available surface area. There is obviously more surface area available per unit volume when the plume is at higher concentrations than when it is at lower concentrations. Dispersing the plume will lessen its impact, not heighten it.

p. 3-13, 6[th] paragraph, last sentence:

5B-13 Comment: The paper of Jackman et al., in which the potential stratospheric impact of the alumina from SRMs is discussed, is referenced. It should be noted that additional work conducted under the RISO program (see "In Situ Measurements of the Aerosol Size Distribution in Stratospheric Solid Rocket Motor Exhaust Plumes," Ross et al., Geophys. Res. Lett. 26, 819-822 (1999)) has shown that the alumina particle size distribution assumed by Jackman significantly overestimates the available alumina surface area, so the potential impact of the alumina would be lessened accordingly.

p. 3-14, 1[st] complete paragraph:

5B-14 Comment: It is true that several studies have examined the impacts to stratospheric ozone of NOx, and have shown that chlorine compounds dominate the chemistry of ozone depletion. It should also be pointed out, however, that these have been theoretical calculations that have not been validated with measured data. Recent measurements made by the RISO and ACCENT programs have shown ozone destruction in the wake of Delta rockets (LO_2/RP-1 main engines with SRM strap-ons) that does not appear to be explainable based on chlorine chemistry alone. The SEIS makes no mention of HOx chemistry, which could also play a role in ozone destruction.

p. 3-14, 2[nd] complete paragraph, 1[st] and 2[nd] sentences:

5B-15 **Comment:** It should be noted that at the same time they measured ozone in the wake of a Titan III rocket, Pergament et al. study also measured NOx levels, and found them to be greatly elevated over the background. In fact, the authors of the paper ascribed the ozone destruction to the NOx compounds rather than to chlorine.

5B-16 **p. 3-14, 2nd complete paragraph, 4th sentence:**

> "Also, effects like the scattering of UV by plume aerosols and the shearing from differences in the winds at different altitudes may help mitigate the short-term impact from a launch."

Comment: No references are given to support this statement. In fact, a much stronger statement could be made here. The RISO program deployed ground based lidar and UV monitors for several launches to determine whether or not local ozone holes could form after a launch, and whether the ground level UV would increase as a result. It was found that although there was considerable (100 percent at times) ozone destruction within the rocket plumes, the shearing action of the stratospheric winds were such that the plume rapidly broke into thin discs no more than a few hundred meters thick. There were never any more than about three discs in a given line of sight from the ground. The result was that there was no increase in ground-level UV intensity measured (to the accuracy of the instruments), virtually eliminating the whole local ozone hole concern.

p. 3-14, 2nd complete paragraph, 5th sentence:

> "From stratospheric aircraft measurements, Ross, et al. (1997) reported ozone concentrations dropped to near zero at nighttime, in the wake of a Titan IV B0 vehicle with SRMs."

5B-17 **Comment:** This statement is incorrect. Strictly speaking, none of the RISO measurements reported by Ross were made at nighttime. Since the pilot of the WB-57 used in the RISO measurements used visual observation to determine his flight path for the plume intercepts, nighttime intercepts were not possible. However, there were measurements made on the exhaust cloud of a Titan IV launch that occurred at sunset. This is likely the data to which the EELV SEIS authors are referring, although they misread the results. In the sunset launch, there was little ozone destruction measured, indicating that sunlight is required to trigger the ozone chemistry in the wake of solid rocket motors (no liquid motors are burning on the Titan IV launch vehicle as it passes through the lower stratosphere). As mentioned above, daytime observations did show that ozone in the wake of Titan, Shuttle and other vehicles dropped to near zero.

p. 3-14, 4th and 5th complete paragraphs

5B-18 **Comment:** The correct reference should be 'Ryage and Ross (1995)' rather than 'Ryage (1995)'. Even at that, a better reference would be "Local Effects of Solid Rocket Motor Exhaust on Stratospheric Ozone," M. N. Ross, J. Spacecraft and Rockets, 33, 144-153 (1996), which contains a much more detailed discussion of the study.

The entire discussion on this page revolves around local ozone holes and the potential for transient increases in UV light at ground level. It is inconceivable that an author acquainted with the work in this field would be unaware of the significant field work that has been done over the past several years by the RISO and ACCENT programs. It is very misleading to cite model studies that predict 20 to 50 percent columnar ozone destruction 3 hours after a launch (p. 3-14, 4th complete paragraph, 1st sentence) without also citing the field data that show this model to be incorrect. Except for the misstated conclusion of Ross's data discussed in the previous paragraph, nowhere in the 2nd through 5th paragraphs on page 3-14 is any reference made to the RISO or ACCENT results. These programs have provided the definitive experimental data on the topic of local transient ozone destruction in the wake of launch vehicles. Their omission from this portion of the SEIS greatly lessens its credibility.

p. 3-14, final paragraph:

5B-19 **Comment:** A brief discussion is made for the potential effects of ozone loss and increased stratospheric aerosols on the thermal balance of the stratosphere. While the discussion is essentially correct in what it says, it is never put into context by comparing the magnitude of these impacts with those of other anthropogenic or natural sources, nor does it include other species that could also affect the thermal balance of the stratosphere. The reader is left to wonder if the thermal balance of the stratosphere will be insignificantly changed, marginally changed or substantially changed by the aerosols from rockets. For example, based on a launch rate of 9 Shuttles and 3 Titan IVs, the injection of alumina into the stratosphere from these rockets adds several orders of magnitude less aerosol surface area to the stratosphere than a single large volcano (the surface area of the alumina from 9 Shuttles and 3 Titan IV rockets is equivalent to about 0.001 percent of a volcano such as El Chichon), and particles the

background stratospheric surface area by about 0.08 percent. The expected impact on the thermal balance of the stratosphere is thus extremely small.

The glaring omissions from this discussion on thermal balance are the CO_2 and H_2O emissions from the EELV, which will mainly come from the LO_2/RP-1 engines. Both of these species have been identified as greenhouse gases and should be included in any discussion of the impacts of rockets on the thermal balance of the atmosphere.

Section 4

Table 4.11-2

SB-20 Comment: This table incorrectly lists the stratospheric particulate emissions for an Atlas V as zero. The Atlas V is a LO_2/RP-1 vehicle, and as such, has soot and sulfate aerosol emissions on the order of 1 percent. Soot emissions from aircraft have been sampled and evaluated and found to consist of very small spheres on the order of 20 nm that are agglomerated together to form particles about 0.1 μ in size (see, for example, S. Baldi, J. Geophys. Res., 102(D9), pp 10751-10758 (1997)). Since surface area scales with the inverse of the mean particle diameter, 1 g of 20 nm particles will have the same total surface area as 50 g of 1 μ particles. The soot from LO_2/RP-1 engines could therefore have as much surface area as the alumina from SRMs. Thus a discussion on the potential impacts of condensed phase species should consider all species and not just those from SRMs.

Table 4.11-3

SB-21 Comment: Although it is included as such, HCl is not a Clx species. Clx is the sum of the reactive forms of chlorine such as Cl and ClO.

Table 4.11-4 and 4.11-6, p. 4-88 and 4-91

SB-22 Comment: These two tables show calculated ozone depletion hole sizes at an altitude of 20 km for the Atlas V 551/552 and Delta IV M+ vehicles, respectively, compared with other vehicles such as Shuttle, Titan, Atlas IIAS and Delta II. Based on the actual measurements made by the RISO/ACCENT programs over the past several years (see, for example, EOS, Trans., AGU, 80(38), pp. 436-443 (1999)), the calculated values given in these two tables for Delta II and Atlas IIAS are wrong by 2-3 orders of magnitude, rendering the tables worthless. The claim is made in Tables 4.11-4 and 4.11-6 that the ozone depletion in the wake of an Atlas V or Delta IV M+ will be only 1-4 minutes in duration. In reality, ozone loss in the plumes of the Delta II and Atlas IIAS vehicles lasts about as long as it does for the Titan IV and Shuttle vehicles – on the order of 1-2 hours. The term 'ozone hole' in these tables is not defined. Do the authors mean ozone depletion at a given altitude, ozone depletion along a given line of sight through the atmosphere, a vertical column, or something else? No definition is given.

It is puzzling why the authors chose to focus on the calculations showing the potential for up to 50% columnar ozone depletion for 3 hours after a rocket launch in section 3 of the SEIS, but do not mention the data shown in this section that tell a completely different story – that ozone losses in the exhaust plume last less than five minutes for the Atlas V/Delta IV size vehicles. No discussion is given as to which of these very different estimates is likely to be correct, and the authors unfortunately neglect to cite the actual measured data that show neither to be. Giving the authors the benefit of the doubt, they were apparently unaware of the RISO field measurements when this document was prepared.

Further, the values given for ozone destruction in these tables were calculated based on chlorine emissions from SRMs only, but this is not stated.

SB-23 p. 4-92, 1st paragraph:

> "Because launches at the two ranges are always separated by at least a few days, combined impacts in the sense of these local holes combining or reinforcing one another cannot occur. However there is the potential for a secondary combined impact from the repeated local reduction of the stratospheric ozone concentration."

Comment: What is this 'secondary combined impact'? It is never defined, explained or justified.

SB-24 P. 4-92, Section 4.11-4, 1st paragraph:

> "Assuming that the Proposed Action would deposit 830 tons (see Table 4.11-8, Cape Canaveral AS + Vandenberg AFB combined) of chlorine and Al_2O_3 in the stratosphere every year, the estimated global average ozone reduction would be approximately 0.014 percent per year."

Comment: This statement is incorrect. The authors stated that this estimate is based on an extrapolation from Jackman's data. Jackman's estimate of 0.033 percent global ozone loss from the annual launches of 9 Shuttles and 3 Titan IVs is a steady-state value, meaning the long term change in global ozone after years of launching. It is not 0.033 percent per year. In other words, 0.033 percent is the cumulative change, not the annual change (which would be additive from year to year). The same would apply to the value of 0.014 percent given for the Proposed Action.

Furthermore, Jackman's calculation of global ozone depletion is based in part on an overestimation of the surface area of the alumina in the stratosphere (see "In Situ Measurement of the Aerosol Size Distribution in Stratospheric Solid Rocket Motor Exhaust Plumes," Ross et al., Geophys. Res. Lett. 26, 819-822 (1999)). It is thus likely that Jackman overestimates the global stratospheric ozone reduction from the chlorine and alumina emissions of rockets by about 30 percent.

As with other sections in the SEIS, this section is flawed by the omission of any mention of other potential ozone destroying chemistries, such as those involving soot, HOx or NOx.

SB-25

p. 4-93, Section 4.11.3 No-Action Alternative

> "The Atlas V lift vehicles use a common core booster that burns RP-1 and LO_2, which results in emissions of mainly CO_2 and H_2O, with small quantities of NOx and CO. Because the quantity of NOx emitted is small, and the other compounds do not affect stratospheric ozone depletion, the impact of the No-Action Atlas V to stratospheric ozone would be negligible."

Comment: There are problems with this statement. If it were true that water, CO_2 and small quantities of NOx and CO were the only emissions from an RP-1/LO_2 engine, then this statement would be reasonably accurate (although water can enter into ozone depletion cycles as well). However, as discussed above, it is well known that RP-1/LO_2 engines are not completely efficient in their combustion processes, and a significant amount of soot is produced. While the precise chemical nature of the soot from a given engine is not well understood, there have been a number of publications discussing the reactivity of ozone and soot. The soot could serve the same purpose as the alumina that this SEIS is so careful to note can potentially destroy ozone. It can act as a catalytic surface to directly dissociate ozone into oxygen atoms and molecules, or it could act as a catalyst to release chlorine from reservoir species. To date, there have been no in situ measurements directly on the emissions from a pure LO_2/RP-1 vehicle, so the above quote is relying on computer model data that has not been verified. The RISO/ACCENT programs have collected sufficient data from Delta II and Atlas IIAS launch vehicles to suggest that there may well be a contribution to stratospheric ozone depletion from LO_2/RP-1 vehicles of at least the same order of magnitude as that from SRMs, and possibly more. It is thus by no means clear that the No-Action Alternative will result in any less impact on stratospheric ozone than the proposed use of SRM strap-on rockets.

SB-26

In summary, the upper atmosphere portions of the EELV SEIS are in need of significant reworking. Rather than simply reporting the calculations from various modeling studies that give very different results, there should be an attempt to use the experimental data that has been collected to evaluate which model, if any, accurately reflects reality. The potential impact of the LO_2/RP-1 engine effluents on stratospheric ozone should not be underestimated, and it should be recognized that species other than chlorine and alumina, such as soot, could affect ozone similarly. The whole question of the potential for localized ozone holes has been answered with the RISO data, which showed very little potential for extensive ozone depletion because of the horizontal shearing of the exhaust cloud.

Questions on the above comments can be answered by contacting

Dr. Robert R. Bennett
Thiokol Propulsion
MS 243, PO Box 707
Brigham City, UT 84302
Ph: 435-863-8263
Fax: 435-863-2271
Email: [illegible]

[illegible]
University of California
Santa Barbara, CA 93106
[illegible]

6

Mr. Jonathan Farthing
Chief, Environmental Analysis Division
HQ AFCEE/ECA

Dear Mr. Farthing:

This letter will serve two purposes. The first is to serve as an introduction to the letter of my colleague Alexander Yumakaev, Altai, Russia. Because of email difficulties coupled to the impossibility of faxing his letter directly to you, Alexander send me an email of the file for his letter, which I have printed out and am faxing to you, along with this. Unfortunately, because of the Xmas holidays the departmental office at UCSB is closed, so I will have to fax both these letters from a commercial place. However, in the case of Alexander and myself, the various addresses and numbers we list in our letters are the appropriate ones to respond to.

The second purpose of this letter is to make my own comments on the draft SEIS.

6-1 I am concerned that there is no mention of any potential impacts the proposed activities might have on the current and possibly enlarged Channel Islands National Marine Sanctuary, which is not even listed as a consulted federal agency for the draft SEIS. In comments I have made for scoping issues for the proposed enlargement of the CINMS, I noted that the draft document notes that: (1) all extant military activities that might have any significant impacts on the Sanctuary are vital to national defense, and hence exempted from compliance with the standards of NEPA, etc; and (2) any proposed new military activities potentially impacting the sanctuary will be negotiated directly between the CINMS director and appropriate DOD officials as necessary.

I note, for the record, that: (1) not all military activities potentially impacting the sanctuary are actually vital to national defense; and (2) direct negotiation over additional activities between the sanctuary director and DOD officials without public participation violates NEPA, the ESA, a variety of international treaties, and the letter and spirit of the organic acts governing responsibilities of both the CINMS and the Department of Defense.

Please record both of our letters for your SEIS process, and please address our stated concerns. We request written responses to our issues drafted as the final Records of Decisions on this matter, the responses sent to our mailing addresses as indicated.

Thank you very much for the opportunity to respond to this issue, and good luck with the progress of the SEIS.

Yours,

[signature]

The Fund for 21[st] Century Altai
P.O.Box #845 Barnaul 656015 Russia
Tel/Fax: +7 (3852) 222-371 E-mail: [illegible]

7

To: Mr. Jonathan D. Farthing
Chief, Environmental Analysis Division
HQ AFCEE/ECA
3207 North Road
Brooks Air Force Base
TEXAS 78235-5363 USA
Telephone number (210) 536-3668
Facsimile number (210) 536-3890

Dear Mr. Farthing,

My name is Alexander Yumakaev, I am writing to you on behalf of The Fund for 21[st] Century Altai. Altai is the area in southwestern Siberia, Russia, and it suffers harmful fuel pollution caused by the rocket launches made from Baikonur. My organization is an environmental NGO working for years on problems of nature conservation, and the impacts to the environment caused by space industry are constantly in the focus of our activity.

7-1 Besides the local problem of toxic fuel pollution from falling boosters, we are concerned of global impacts brought by any space industry program. Among these impacts are destruction of the Earth's atmosphere, particularly regarding vulnerable ozone layer and wasted oxygen, threatened biosphere, distortion of an electromagnetic field of the Earth, contamination of near-Earth space with non-operational stages and satellites, and others. Another important issue is failures and error calculations that often occur in space programs and might have disastrous consequences. As having global influence, all these issues must take any space program out of exclusive competence of developers, and bring it to broad discussion worldwide.

Recently I have learnt about the U.S. Air Force Evolved Expendable Launch Vehicle Program, that envisages to add more solid rocket motors (SRMs) to the Atlas V system and to use larger SRMs on the Delta IV system. I have also learnt about the draft Supplemental Environmental Impact Statement (SEIS) prepared for that program and available in the Internet for review and comments. Unfortunately, I do not have an Internet facility, and therefore cannot study this document in detail. However, I expect that the above listed issues of space program threats will be promptly addressed in the final version of SEIS.

I also would like you to officially record my comments for the SEIS document, and hope that you will provide me with copies of all subsequent correspondence about the matter. Please mail them to me to

The Fund for 21[st] Century Altai
P.O.Box #845, Barnaul, 656015, Russia

With any questions and/or comments you can also contact me anytime through my email address: [illegible]

With the hope to future collaboration,

Alexander Yumakaev

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

8

"Dedicated to making Florida a better place to call home"

received

December 21, 1999

Mr. Jonathan D. Farthing, Chief
Department of the Air Force
Environmental Analysis Division
HQ AFCEE/ECA
Brooks AFB, Texas 78235-5363

RE: Department of the Air Force - Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program - November 1999 - Cape Canaveral, Brevard County, Florida
SAI: FL9912150908C

Dear Mr. Farthing:

8-1 The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the above-referenced project.

The St. Johns River Water Management District (SJRWMD) notes that comments on the original draft environmental impact statement (EIS) were presented in SJRWMD's letter of January 6, 1998, and that SJRWMD has no additional comments on the draft supplemental EIS. For more specific permitting information, the applicant should contact the SJRWMD's Orlando Service Center. Please refer to the enclosed SJRWMD comments.

Based on the information contained in the draft supplemental environmental impact statement and the enclosed comments provided by our reviewing agencies, the state has determined that the above-referenced project is consistent with the Florida Coastal Management Program.

2555 SHUMARD OAK BOULEVARD • TALLAHASSEE, FLORIDA 32399-2100

Thank you for the opportunity to review this project. If you have any questions regarding this letter, please contact Ms. Cherie Trainor, Clearinghouse Coordinator, at (850) 414-5495.

Sincerely,

Ralph Cantral, Executive Director
Florida Coastal Management Program

RC/cc

Enclosures

cc: Margaret Spontak, St. Johns River Water Management District

Jeb Bush
Governor

Department of Environmental Protection

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000
December 10, 1999

David B. Struhs
Secretary

Cherie Trainor
State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100

RE: USAF/Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program, Brevard County

SAI: FL9911160908CA

Dear Ms. Trainor:

The Florida Department of Environmental Protection (FDEP) has completed its review of the materials that were provided for the above-referenced project. The Department has no objections to the project as proposed at this time, based on the information provided.

Thank you for the opportunity to comment on this project. If I can be of further assistance, please contact me at (850) 487-2231.

Sincerely,

Marlene Castellanos

Marlene Castellanos
Office of Legislative and Governmental Affairs

MC/

RECEIVED DEC 13 1999 [illegible]

COUNTY: BREVARD

Message:

DATE:	11/16/1999
COMMENTS DUE-2 WKS:	11/23/1999
CLEARANCE DUE DATE:	12/24/1999
SAI#:	FL9711160908CR

STATE AGENCIES	WATER MANAGEMENT DISTRICTS	OPB POLICY UNITS
Community Affairs Environmental Protection X Fish & Wildlife Conservation Comm OTTED State Transportation	St. Johns River WMD	Environmental Policy/C & ED

RECEIVED NOV 1 [illegible] 1999 State of Florida Clearinghouse

RECEIVED BY GRC NOV 1 2 1999 OFFICE OF ENVIRONMENTAL SERVICES

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

___ Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

X Direct Federal Activity (15 CFR 930, Subpart C). Federal Agencies are required to furnish a consistency determination for the State's concurrence or objection.

___ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

___ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

Project Description:

Department of the Air Force - Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program - November 1999 - Cape Canaveral, Brevard County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 922-5438 (SC 292-5438)
(850) 414-0479 (FAX)

EO. 12372/NEPA

- [x] No Comment
- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency

- [x] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

From:

Division/Bureau: ENVIRONMENTAL SERVICES

Reviewer: BRIAN BARNETT

Date: 11/15/99

COUNTY: Brevard

DATE: [illegible]
COMMENTS DUE DATE: 12/23/1998
CLEARANCE DUE DATE: 12/24/1998
SAI#: FL9712150808CR

Message:

STATE AGENCIES	WATER MANAGEMENT DISTRICTS	OPB POLICY UNITS
Community Affairs Environmental Protection Fish & Wildlife Conserv. Comm. OTTED State X Transportation	St. Johns River WMD	Environmental Policy/C & ED

The attached document requires a Coastal Zone [illegible] Coastal Management Program consistency evalu[illegible] as one of the following:

— Federal Assistance to State or Local Gov[illegible] Agencies are required to evaluate the co[illegible]

X Direct Federal Activity (15 CFR 930, Sub[illegible] required to furnish a consistency determ[illegible] concurrence or objection.

— Outer Continental Shelf Exploration, Dev[illegible] Activities (15 CFR 930, Subpart E). Opera[illegible] consistency certification for state concurrence/objection.

— Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

[illegible] NOV [illegible] 1998

State of Florida Clearinghouse

Description:

[illegible] of the Air Force - Draft Supplemental [illegible] Impact Statement for the Evolved [illegible] Launch Vehicle Program - Cape [illegible] Canaveral, Brevard County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 922-5438 (SC 292-5438)
(850) 414-0479 (FAX)

EO. 12372/NEPA

- [x] No Comment
- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency

- [x] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

From:
Division/Bureau: [illegible]
Reviewer: R. J. [illegible], Jr.
Date: 11/18/98

WATER MANAGEMENT DISTRICT

POST OFFICE BOX 1429 PALATKA, FLORIDA 32178-1429

November 24, 1998

Ms. Cherie Trainor
Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Blvd.
Tallahassee, FL 32399-2100

Re: SAI #: FL9712150808CR OPP #: 1555
Name of Project: USAF - Draft Supplemental EIS for the Evolved Expendable Launch Vehicle Program - Cape Canaveral, Brevard County, Florida

Dear Ms. Trainor:

Selected staff of the St. Johns River Water Management District (SJRWMD) have reviewed the above referenced project and offer the following comments regarding the District's areas of responsibility which include water quality, water supply, flood protection, and natural systems.

Comments on the original draft EIS were presented in SJRWMD's letter of January 6, 1998 (copy enclosed), and Staff has no additional comments on the draft Supplemental EIS.

For more specific information concerning permitting, the applicant should contact SJRWMD's Orlando Service Center at (407) 897-4300.

If you have any questions about our comments, please contact me at (904) 329-4374.

Sincerely,

Margaret H. Spontak

Margaret H. Spontak, Director
Office of Policy and Planning

MK/RSG

COUNTY: Brevard

DATE: 11/09/1999
COMMENTS DUE-2 WKS: 11/23/1999
CLEARANCE DUE DATE: 12/24/1999
SAI#: FL9711215080BCR

Message:

STATE AGENCIES	WATER MANAGEMENT DISTRICTS	OPB POLICY UNITS
Community Affairs Environmental Protection Fish & Wildlife Conserv. Comm OTTED State Transportation	St. Johns River WMD	Environmental Policy/C & ED

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

— Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

X Direct Federal Activity (15 CFR 930, Subpart C). Federal Agencies are required to furnish a consistency determination for the State's concurrence or objection.

— Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

— Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

Project Description:

Department of the Air Force - Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program - November 1999 - Cape Canaveral, Brevard County, Florida

Sorting per resident in the [illegible] [illegible] [illegible] policy

To: Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 922-5438 (SC 292-5438)
(850) 414-0479 (FAX)

EO. 12372/NEPA
- [x] No Comment
- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency
- [ ] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

From:
Division/Bureau: [illegible]
Reviewer: [illegible]
Date: [illegible]

FLORIDA STATE CLEARINGHOUSE
RPC INTERGOVERNMENTAL COORDINATION AND RESPONSE SHEET

SAI#: FL9711215080BCR DATE: 11/09/1999
COMMENTS DUE TO CLEARINGHOUSE: 12/09/1999

AREA OF PROPOSED ACTIVITY: COUNTY: Brevard County

- [ ] FEDERAL ASSISTANCE
- [x] DIRECT FEDERAL ACTIVITY
- [ ] FEDERAL LICENSE OR PERMIT
- [ ] OCS

PROJECT DESCRIPTION
Department of the Air Force - Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program - November 1999 - Cape Canaveral, Brevard County, Florida.

ROUTING: RPC
X E. Central FL RPC

PLEASE CHECK ALL THE LOCAL GOVERNMENTS BELOW FROM WHICH COMMENTS HAVE BEEN RECEIVED. ALL COMMENTS RECEIVED SHOULD BE INCLUDED BY THE RPC'S CLEARINGHOUSE RESPONSE PACKAGE. IF NO COMMENTS WERE RECEIVED, PLEASE CHECK "NO COMMENT" BOX AND RETURN TO CLEARINGHOUSE.

COMMENTS DUE TO RPC: 11/30/1999

NO COMMENTS: ✓
(IF THE RPC DOES NOT RECEIVE COMMENTS BY THE DEADLINE DATE, THE RPC SHOULD CONTACT THE LOCAL GOVERNMENT TO DETERMINE THE STATUS OF THE PROJECT REVIEW PRIOR TO FORWARDING THE RESPONSE PACKAGE TO THE CLEARINGHOUSE.)

NOTES:

ALL CONCERNS OR COMMENTS REGARDING THE ATTACHED PROJECT (INCLUDING ANY RPC [illegible]) PLEASE ATTACH THIS RESPONSE FORM AND REFER TO THE SAI # IN ALL CORRESPONDENCE.

IF YOU HAVE ANY QUESTIONS REGARDING THE ATTACHED PROJECT, PLEASE CONTACT THE STATE CLEARINGHOUSE AT (850) 922-5438 OR SUNCOM 292-5438.

9

FLORIDA DEPARTMENT OF STATE
Katherine Harris
Secretary of State

DIVISION OF HISTORICAL RESOURCES

December 8, 1999

Ms. Lynn A. Engelman
Department of the Air Force
HQ USAF/ILEVP
1260 Air Force Pentagon
Washington, DC 20330-1260

RE: DHR Project File No. 998324
Cultural Resource Assessment Request
Draft Supplemental Environmental Impact Statement (SEIS)
for the Evolved Expendable Launch Vehicle (EELV) Program
Cape Canaveral, Brevard County, Florida

Dear Ms. Engelman:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project for possible impact to historic properties listed, or eligible for listing, in the *National Register of Historic Places*. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

9-1 We have reviewed the referenced draft supplemental environmental impact statement. We specifically reviewed sections 3.15 and 4.15 both dealing with cultural resources. We note that a previous survey was conducted for the Cape Canaveral Air Force Station and based on that survey, Hangars C and J were determined eligible for listing in the National Register. Therefore, it is our opinion that the project will have no adverse effect on Hangars C and J.

If you have any questions concerning our comments, please contact Scott Edwards, Historic Preservation Planner, at 850-487-2333 or 800-847-7278. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Janet Snyder Matthews, Ph.D., Director
Division of Historical Resources
State Historic Preservation Officer

JSM/Ese

ORIGINAL

PUBLIC HEARING REGARDING
EVOLVED EXPENDABLE LAUNCH VEHICLE

10

DECEMBER 9, 1999
LOMPOC, CALIFORNIA

PRESENTERS: COL. MICHAEL McSHANE
LT. COL. ROGER ODLE
DALE CLARK

REPORTED BY: JOYCE L. GOBLE, CSR. 6976

Elite Court Reporters
301 E. Cook Street, G-2
Santa Maria, California 93454
(805) 922-6925

COL. McSHANE: OKAY, I WOULD LIKE TO HAVE EVERYONE PLEASE COME ON IN AND HAVE A SEAT. THE LIGHTS ARE NOT OUT TO PUT YOU TO SLEEP THEY ARE OUT SO YOU CAN SEE THE SLIDE SHOW A LITTLE BIT BETTER. MAYBE WE SHOULD LEAVE THAT BACK DOOR OPEN SO THAT PEOPLE WILL REALIZE WE ARE IN HERE AND KEEP COMING IN.

GOOD EVENING FOLKS AND WELCOME TO THE PUBLIC HEARING ON THE DRAFT ENVIRONMENTAL -- SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE IMPLEMENTATION OF THE EVOLVED EXPENDABLE LAUNCH VEHICLE OR EELV SYSTEMS AT CAPE CANAVERAL AIR STATION IN FLORIDA AND AT VANDENBERG AIR FORCE BASE IN CALIFORNIA. THANK YOU FOR COMING TONIGHT, AS WE ELICIT YOUR COMMENTS AND INVOLVEMENT IN TONIGHT'S HEARING.

I AM COLONEL MIKE McSHANE AND I WILL SERVE AS THE PRESIDING OFFICER FOR THIS HEARING. I AM THE CHIEF TRIAL JUDGE FOR THE UNITED STATES AIR FORCE AND I AM ASSIGNED AT BOLLING AIR FORCE BASE IN WASHINGTON, D.C.

I WOULD LIKE TO INTRODUCE TO YOU THE MEMBERS OF TONIGHT'S PANEL. LIEUTENANT COLONEL ROGER ODLE IS THE CHIEF OF LAUNCH SITE ACTIVATION AND OPERATIONS FOR THE EELV PROGRAM OFFICE AT THE SPACE AND MISSILE SYSTEMS CENTER IN LOS ANGELES. HIS OFFICE IS RESPONSIBLE FOR IMPLEMENTING EELV FOR THE AIR FORCE. MR. DALE CLARK OF THE AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE WILL EXPLAIN THE

ENVIRONMENTAL IMPACT ANALYSIS PROCESS AND GIVE US A SUMMARY OF THE RESULTS OF THE DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT.

AS THE PRESIDING OFFICER FOR THIS HEARING, I AM NOT ACTING AS A LEGAL ADVISOR TO THE AIR FORCE REPRESENTATIVES WHO WILL ADDRESS THIS ACTION. I AM NOT HERE AS AN AUTHORITY ON THE DRAFT SEIS, NOR HAVE I HAD ANY INVOLVEMENT WITH ITS DEVELOPMENT. MY PURPOSE HERE TONIGHT IS THAT WE HAVE AN ORDERLY HEARING AND THAT EVERYONE WHO WISHES TO PROVIDE INPUT OR PROVIDE A COMMENT HAS A FAIR OPPORTUNITY TO SPEAK AND TO BE HEARD.

I WOULD LIKE TO EXPLAIN THE PUBLIC HEARING PROCESS AND PROCEDURES THAT WE WILL FOLLOW THIS EVENING. THE AIR FORCE HAS PREPARED A DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT AND WE WILL BE CALLING THAT THE DRAFT SEIS THROUGHOUT THE EVENING, ON THE EVOLVED EXPENDABLE LAUNCH VEHICLE THAT WAS ANALYZED AND APPROVED FOR IMPLEMENTATION BACK IN 1998. THIS HEARING IS BEING HELD IN ACCORDANCE WITH THE PROVISIONS OF THE NATIONAL ENVIRONMENTAL POLICY ACT AND YOU WILL HEAR US CALL THAT NEPA DURING THE EVENING, AND THE AIR FORCE IMPLEMENTING INSTRUCTIONS. THE PURPOSE OF THIS HEARING IS TO SUMMARIZE FOR YOU THE RESULTS OF THE DRAFT SEIS AND TO RECEIVE YOUR COMMENTS ON THE DRAFT SEIS.

TONIGHT'S HEARING WILL BE IN TWO PARTS. DURING THE FIRST PART COLONEL ODLE AND MR. CLARK WILL

PROVIDE INFORMATION TO YOU CONCERNING ENVIRONMENTAL IMPACT ANALYSIS PERFORMED FOR THE PROGRAM. THE SECOND PART OF THE HEARING IS THE PUBLIC PARTICIPATION PORTION WHERE YOU WILL HAVE THE OPPORTUNITY TO COMMENT ON THE DRAFT SEIS.

THIS HEARING IS INTENDED TO PROVIDE A PUBLIC FORUM FOR TWO-WAY COMMUNICATION ABOUT THE DRAFT SEIS WITH A VIEW TO IMPROVING THE DECISION MAKING PROCESS. YOUR INPUT WILL ENSURE THAT THE DECISION MAKERS HAVE THE BENEFIT OF YOUR KNOWLEDGE OF THE LOCAL AREA AND ANY ADVERSE ENVIRONMENTAL EFFECTS THAT YOU THINK MAY RESULT FROM THE PROPOSED ACTION OR ALTERNATIVE.

LET ME TELL YOU WHAT THE HEARING IS NOT. IT IS NOT A DEBATE, NOR IS IT A REFERENDUM, NOR IS IT A VOTE ON THE ACTIONS THAT HAVE BEEN ANALYZED IN THE DRAFT SEIS. THE FOCUS OF THE HEARING IS ONLY THE ENVIRONMENTAL IMPACTS ASSOCIATED WITH THE PROPOSALS BEING STUDIED BY THE AIR FORCE. COMMENTS ON NON ENVIRONMENTAL ISSUES SHOULD NOT BE RAISED AT THIS HEARING. MOREOVER, NONE OF THE PANEL MEMBERS ARE AIR FORCE DECISION MAKERS ON THIS PROJECT.

WHEN YOU CAME IN TONIGHT YOU WERE PROVIDED WITH AN ATTENDANCE CARD THAT LOOKS LIKE THIS. SHE SHOULD HAVE HAD YOU FILL IT OUT AT THE DOOR. YOU CAN INDICATE ON THAT CARD WHETHER YOU WANT TO MAKE A STATEMENT TONIGHT. AFTER THE PRESENTATION BY COLONEL ODLE AND MR. CLARK WE WILL TAKE A SHORT BREAK AND I

[illegible]

[illegible]

THE GOVERNMENT'S FORECASTED LAUNCH REQUIREMENTS AND REDUCES THE COST OF SPACE LAUNCH BY AT LEAST 25 PERCENT. THE EELV SYSTEM IS ALSO EXPECTED TO INCREASE U.S. INDUSTRY'S COMPETITIVENESS IN THE INTERNATIONAL SPACE LAUNCH MARKET.

THE EELV PROGRAM IS A FAMILY OF UNMANNED, EXPENDABLE SPACE LAUNCH VEHICLES THAT EVOLVED FROM EXISTING SYSTEMS. THE EELV WILL ULTIMATELY BE THE DEPARTMENT OF DEFENSE'S SOLE SOURCE OF EXPENDEBLE MEDIUM AND HEAVY LIFT TRANSPORTATION. IT WILL ALSO BE CAPABLE OF LAUNCH CIVIL, WHICH INCLUDES THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION OR NASA'S PAYLOAD AND OTHER GOVERNMENT SATELLITES. THE EELV IS ALSO EXPECTED TO LAUNCH A SUBSTANTIAL NUMBER OF COMMERCIAL SATELLITES.

EACH CONTRACTOR'S EELV PROGRAM CONSISTS OF A FAMILY OF MEDIUM LIFT LAUNCH VEHICLES AND HEAVY LIFT LAUNCH VEHICLES LAUNCHED FROM COMPLEXES AT BOTH CAPE CANAVERAL AIR STATION AND VANDENBERG AIR FORCE BASE. EELV FLIGHTS WILL BEGIN IN THE YEAR 2001 AND CONTINUE TO THE YEAR 2020. CONSTRUCTION ACTIVITIES NECESSARY TO IMPLEMENT THE PROGRAM WERE APPROVED IN THE 1998 FEIS AND HAVE ALREADY BEGUN AT BOTH BASES. THE EELV PROGRAM WILL ULTIMATELY REPLACE CURRENT ATLAS, DELTA AND TITAN LAUNCH VEHICLES CURRENTLY FLOWN FROM CAPE CANAVERAL AND VANDENBERG AIR FORCE BASE.

THE DRAFT SEIS DESCRIBES THE PROPOSED CHANGES FROM THE 1998 FINAL EIS THAT WAS APPROVED BY

IMPLEMENTATION WHEN THE RECORD OF DECISION WAS SIGNED BY THE AIR FORCE ON JUNE 8, 1998.

LOCKHEED MARTIN PROPOSES TO ADD UP TO FIVE STRAP-ON SOLID ROCKET MOTORS OR SRM'S TO THEIR CURRENT ATLAS FIVE LAUNCH VEHICLE.

BOEING PROPOSES A DELTA IV MEDIUM LAUNCH VEHICLE WITH TWO OR FOUR STRAP-ON SRM'S THAT ARE LARGER THAN THOSE PREVIOUSLY ANALYZED IN THE 1998 FEIS.

IN BOTH COMPANY'S PROPOSALS THE SRM'S WILL BE MANUFACTURED AT OFF-SITE FACILITIES, AND THE MATERIALS USED ARE CURRENTLY USED ON PROGRAMS FLOWN AT BOTH LAUNCH BASES.

BOTH CONTRACTORS ARE EXPECTED TO USE EELV SYSTEMS TO LAUNCH COMMERCIAL PAYLOADS. BECAUSE A POTENTIAL GOVERNMENT NEED ALSO EXISTS FOR THESE PROPOSED SYSTEMS, THE SEIS CONSIDERED THE EFFECTS OF BOTH GOVERNMENT AND COMMERCIAL LAUNCHES.

LOCKHEED MARTIN HAS PROPOSED AN ATLAS V MEDIUM LAUNCH VEHICLE EMPLOYING FIVE SOLID ROCKET MOTORS DEPICTED HERE ON THE SLIDE. AS DESCRIBED IN THE SEIS, THE ACTION PROPOSED BY LOCKHEED MARTIN EMPLOYS THE SAME COMMON CORE BOOSTER AND UPPER STAGE AS A SECOND STAGE AS THE MEDIUM AND HEAVY LIFT VARIANTS APPROVED IN THE FEIS. THE COMMON CORE BOOSTER WOULD USE A PROPELLENT MIXTURE OF RP-1, WHICH IS A KEROSENE TYPE FUEL, AND LIQUID OXYGEN. THE UPPER STAGE WOULD USE LIQUID OXYGEN AND LIQUID HYDROGEN AS

[illegible]

[illegible]

PICKED UP A BUG BETWEEN CAPE CANAVERAL AND HERE. I AM DALE CLARK, THE PROJECT MANAGER AT THE AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE AT BROOKS AIR FORCE BASE IN SAN ANTONIO, TEXAS. THE EELV PROGRAM OFFICE USED OUR ORGANIZATION TO HANDLE THE PREPARATION OF THE 1998 FEIS AS WELL AS THE CURRENT SUPPLEMENTAL ENVIRONMENTAL IMPACT ANALYSIS FOR THE EELV PROGRAM. THE INDEPENDENT ENVIRONMENTAL CONTRACTOR THAT ASSISTED IN THE PREPARATION OF THE DRAFT SEIS IS HERE. I AM GOING TO PROVIDE SOME IMPACT ANALYSIS PROCESS IN GENERAL AND THEN DISCUSS THE DRAFT SEIS THAT HAS BEEN PREPARED FOR THE EELV PROGRAM.

THE NATIONAL ENVIRONMENTAL POLICY ACT OR NEPA, REQUIRES THAT FEDERAL AGENCIES CONSIDER THE ENVIRONMENTAL CONSEQUENCES OF THEIR PROPOSED ACTIONS IN THEIR DECISION-MAKING PROCESS. THE AIR FORCE DECISION WHICH TRIGGERS NEPA WOULD BE TO ALLOW IMPLEMENTATION OF THE PROPOSED REVISIONS TO THE EXISTING EELV PROGRAM AT CAPE CANAVERAL AIR STATION AND VANDENBERG AIR FORCE BASE. WE ARE PREPARING THIS SEIS TO ANALYZE THE POTENTIAL ENVIRONMENTAL CONSEQUENCES OF THAT DECISION. DUE TO THE ANALYSIS OF POTENTIAL COMMERCIAL LAUNCH ACTIVITIES, THE FAA IS SERVING AS A COOPERATING AGENCY IN PREPARATION OF THE SEIS, AS IS NASA.

NEPA ALSO REQUIRES THAT THE PUBLIC BE INCLUDED IN THIS DECISION-MAKING PROCESS. WE PUBLISHED A NOTICE OF INTENT TO PREPARE THE SEIS IN THE <u>FEDERAL REGISTER</u> ON APRIL 12TH, 1999 AND CONDUCTED SCOPING DURING APRIL AND MAY OF THIS YEAR. THE NOTICE DESCRIBED THE PROPOSED REVISIONS TO THE EXISTING EELV PROGRAM, AND REQUESTED PUBLIC INPUT TO THE ISSUES BEING PRESENTED. THE SCOPING PROCESS HELPED GUIDE PREPARATION OF THE DRAFT SEIS. THE DRAFT SEIS WAS MADE AVAILABLE FOR PUBLIC REVIEW AND COMMENT IN NOVEMBER OF 1999. TONIGHT'S PUBLIC HEARING IS A FORMAL MEETING AT WHICH WE REVIEW RESULTS PRESENTED IN THE DRAFT AND RECEIVE PUBLIC COMMENT ON THE DOCUMENT.

ANY COMMENTS MADE ON THE DRAFT SEIS THIS EVENING, WHETHER VERBAL OR WRITTEN, WILL BE PART OF THE PUBLIC RECORD AND WILL BE CONSIDERED AS WE PREPARE THE FINAL SEIS. WRITTEN COMMENTS WILL BE ACCEPTED THROUGHOUT THE PUBLIC COMMENT PERIOD WHICH LASTS UNTIL DECEMBER 27, AS ALREADY TOLD BY COLONEL McSHANE.

AFTER THE END, ALL COMMENTS WILL BE REVIEWED, RESPONSES WILL BE PREPARED, AND THE SEIS MAY BE REVISED, IF NECESSARY. ALL COMMENTS RECEIVED WILL BE PRESENTED IN THE FINAL SEIS, WHICH IS SCHEDULED FOR PUBLICATION IN MARCH OF 2000. FOLLOWING RELEASE OF THE FINAL SEIS AND THE REQUIRED 30 DAY WAITING PERIOD, THE AIR FORCE CAN PUBLISH ITS RECORD OF DECISION, INDICATING ITS DECISION ON ALLOWING IMPLEMENTATION OF THE PROPOSED EELV PROGRAM REVISIONS.

THE THREE MAJOR PORTIONS OF SEIS SUPPLEMENTAL OR OTHERWISE, ARE THE DESCRIPTION OF

ALTERNATIVES, INCLUDING THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE, PRESENTED IN CHAPTER 2; THE DESCRIPTION OF THE AFFECTED ENVIRONMENT, PRESENTED IN CHAPTER 3; AND THE ENVIRONMENTAL CONSEQUENCES OF IMPLEMENTING THE ALTERNATIVES WHICH ARE PRESENTED IN CHAPTER 4.

CHAPTER 2, THE DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION, IS THE HEART OF THE EIS. IT EXPLAINS THE ACTIVITIES THAT ARE BEING PROPOSED. AS ALREADY DESCRIBED BY COLONEL ODLE, THE PROPOSED ACTION IN THE DRAFT SEIS IS TO ADD UP TO FIVE SRM'S TO LOCKHEED'S ATLAS V MEDIUM-LIFT VEHICLE AND ADD TWO TO FOUR SRM'S TO BOEING'S DELTA IV MEDIUM-LIFT LAUNCH VEHICLE PREVIOUSLY ANALYZED IN THE 1998 FEIS.

UNDER THE NO-ACTION ALTERNATIVE, THE EELV PROGRAM THAT WAS ALLOWED FOR IMPLEMENTATION WITH THE RECORD OF DECISION SIGNED IN JUNE OF 1998 WOULD CONTINUE TO BE IMPLEMENTED. THE NO-ACTION ALTERNATIVE IN THE CURRENT SEIS IS ESSENTIALLY THE SAME, AND THE CONCEPT WAS OF THE PROPOSED ACTION OF THE 1998 FEIS. IF THESE NEW ACTIONS ARE NOT ACCEPTED, BOEING AND LOCKHEED MARTIN WOULD SIMPLY CONTINUE TO CONSTRUCT AND OPERATE THEIR SYSTEMS UNDER THE PARAMETERS OF THE 1998 FEIS. NO SRM'S COULD BE USED WITH THE ATLAS V MEDIUM LAUNCH VEHICLE, AND [illegible] SRM'S COULD NOT BE USED WITH THE DELTA IV MEDIUM LAUNCH VEHICLE.

CHAPTER 3 OF THE SEIS DESCRIBES THE

AFFECTED ENVIRONMENT. IT PROVIDES A DESCRIPTION OF THE EXISTING CONDITIONS IN THE PROJECT AREA PRIOR TO IMPLEMENTING THE PROPOSED ACTION, AND SERVES AS A BASELINE FOR ASSESSING ENVIRONMENTAL IMPACTS. SINCE THE CURRENT DOCUMENT IS A SUPPLEMENT TO THE ORIGINAL EIS, MANY OF THE EXISTING CONDITION DESCRIPTIONS ARE INCORPORATED BY REFERENCE FROM THE PREVIOUS DOCUMENT.

CHAPTER 3 OF THE SEIS ALSO DESCRIBES ANY CHANGES FROM THE EXISTING CONDITIONS AS DESCRIBED IN THE EARLIER FEIS.

CHAPTER 4 OF THE SEIS DESCRIBES THE POTENTIAL ENVIRONMENTAL CONSEQUENCES THAT MAY OCCUR AS A RESULT OF IMPLEMENTING A PROPOSED ACTION OR ALTERNATIVE. THE EFFECTS OF EACH ALTERNATIVE ARE COMPARED TO THE PROJECTED BASELINE CONDITIONS OVER THE NEXT [illegible] YEARS, AS DEFINED FOR THE NO-ACTION. CHAPTER 4 INCLUDES ASSOCIATED MITIGATIONS WHERE POTENTIAL IMPACTS HAVE BEEN IDENTIFIED.

THE SPECIFIC ANALYSIS IN CHAPTERS 3 AND 4 ARE GROUPED INTO TWO BROAD CATEGORIES. THE FIRST GROUP, LOCAL COMMUNITY, INCLUDES POPULATION AND EMPLOYMENT, LAND USE, TRANSPORTATION AND UTILITIES. CHANGES IN THESE FACTORS MAY INFLUENCE ENVIRONMENTAL RESOURCES.

THE SECOND GROUP ADDRESSES IMPACTS ASSOCIATED WITH ACTIVITIES AND RESOURCES SUCH AS HAZARDOUS MATERIALS AND WASTE MANAGEMENT, HEALTH AND SAFETY, SOIL AND GEOLOGY, WATER RESOURCES, LOWER AND

UPPER ATMOSPHERE AIR QUALITY, NOISE, ORBITAL DEBRIS, BIOLOGICAL RESOURCES, AND CULTURAL RESOURCES. IN ADDITION, AN ENVIRONMENTAL JUSTICE ANALYSIS WAS PERFORMED AS PART OF THE PROCESS.

THE REMAINDER OF THIS PRESENTATION WILL CONSIST OF A SUMMARY OF THE DRAFT SEIS ANALYSIS RESULTS FOR EACH OF THESE RESOURCES. FOR EACH ISSUE AREA, I WILL ADDRESS POTENTIAL IMPACTS ASSOCIATED WITH EACH INSTALLATION. NEW FACILITY CONSTRUCTION OR GROUND DISTURBANCE TO ACCOMODATE THE EELV PROGRAM AT BOTH INSTALLATIONS WAS ADDRESSED IN THE 1998 FEIS. NO NEW FACILITY CONSTRUCTION OR GROUND DISTURBANCE IS REQUIRED TO SUPPORT THE PROPOSED USE OF SRM'S. ONCE AGAIN, PLEASE KEEP IN MIND WHEN I REFER TO THE NO-ACTION ALTERNATIVE I AM REFERRING TO THE ONGOING IMPLEMENTATION OF THE EELV PROGRAM AS IT WAS PROPOSED IN THE 1998 FEIS EXCEPT FOR THE CHANGES IN LAUNCH RATES DESCRIBED BY COLONEL ODLE AND A FEW OTHERS.

NOW I WILL DISCUSS THE INDIVIDUAL ISSUE AREAS. UNDER THE PROPOSED ACTION, PROGRAM EMPLOYMENT LEVELS AT FULL OPERATION ARE PROJECTED TO REMAIN ESSENTIALLY THE SAME AS THOSE FOR THE NO ACTION.

UNDER BOTH THE PROPOSED ACTION AND THE NO-ACTION ALTERNATIVE, INCREASES IN DIRECT EMPLOYMENT ARE FORECAST DURING CONSTRUCTION ACTIVITIES FOR THE EELV PROGRAM THAT WERE ANALYZED IN THE FEIS. REDUCTIONS OF EMPLOYMENT ARE PROJECTED AS THE EELV PROGRAM IS IMPLEMENTED AND EXISTING VEHICLES ARE

PHASED OUT FOR GOVERNEMENT USE.

LAND USES UNDER THE PROPOSED ACTION AS WELL AS THE NO-ACTION ALTERNATIVE AT BOTH INSTALLATIONS ARE GENERALLY COMPATIBLE WITH EXISTING LANDS USES IN THE SURROUNDING AREAS AND WITH REGIONAL LAND USE PLANS.

DUE TO THE LOCATION OF ALL PROPOSED LAUNCH ACTIVITIES WITHIN THE COASTAL ZONE, COASTAL ZONE CONSISTENCY DETERMINATIONS WERE PREPARED BY THE AIR FORCE FOR SUBMISSION TO THE APPROPRIATE STATE AGENCIES FOR THE 1998 FEIS IN ACCORDANCE WITH THE COASTAL ZONE MANAGMENT ACT. THE CURRENT PROPOSED ACTION HAS BEEN EQUIVALENT TO THE NO-ACTION ALTERNATIVE WITH RESPECT TO POTENTIAL IMPACT TO THE COASTAL ZONE.

UNDER THE PROPOSED ACTION, TRANSPORTATION CONDITIONS REMAIN ESSENTIALLY THE SAME AS THOSE FORECAST FOR THE NO ACTION ALTERNATIVE.

UNDER BOTH THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE UPDATED LAUNCH PAD DELUGE WATER REQUIREMENTS FOR THE ATLAS V VEHICLE WILL GENERATE ADDITIONAL TRUCK TRIPS TO DISPOSE OF THE WASTEWATER AT VANDENBERG AIR FORCE BASE. THE PROPOSED ACTION ALSO REQUIRES A SMALL NUMBER OF ADDITIONAL TRUCK TRIPS FOR DELIVERY OF THE SRM'S. THESE COMBINED ADDITIONAL TRUCK TRIPS, HOWEVER, ARE NOT SUFFICIENT TO REDUCE THE LEVEL OF SERVICE ON LOCAL ROADS.

TEMPORARY INCREASES IN TRAFFIC AROUND

THE LAUNCH COMPLEXES ARE EXPECTED DURING THE CONSTRUCTION PERIODS FOR EELV FACILITIES. HOWEVER, THESE INCREASES ARE EXPECTED TO BE MINOR AND ARE EXPECTED TO REVERT TO PREVIOUS LEVELS ON LINE AS CONSTRUCTION IS COMPLETED.

FOR THE PROPOSED ACTION, UTILITY REQUIREMENTS WILL REMAIN WITHIN THE CAPACITY OF LOCAL PROVIDERS.

UNDER BOTH THE PROPOSED ACTION AND THE NO-ACTION ALTERNATIVE, CONSUMPTION OF UTILITIES SUCH AS POTABLE WATER, WASTEWATER TREATMENT, AND SOLID WASTE WILL LIKELY INCREASE ABOVE CURRENT LEVELS AT BOTH INSTALLATIONS DURING CONSTRUCTION OF THE EELV PROGRAM FACILITIES. HOWEVER, THESE INCREASES ARE WELL WITHIN THE CAPACITY OF ALL THE SYSTEMS ANALYZED AT EACH LOCATION.

FOLLOWING CONSTRUCTION, UTILITY CONSUMPTION IS EXPECTED TO DECREASE ONCE THE EELV PROGRAM IS FULLY IMPLEMENTED AND EXISTING GOVERNMENT LAUNCH PROGRAMS HAVE BEEN PHASED OUT.

UNDER BOTH THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE PROCEDURES ARE IN PLACE IN BOTH INSTALLATIONS TO ENSURE THAT THE GENERAL PUBLIC AND INSTALLATION PERSONNEL ARE NOT EXPOSED TO UNDUE RISK ASSOCIATED WITH HAZARDOUS LAUNCH EVENTS, FIRE PROTECTION, FIRE SUPPRESSION, FLIGHT TERMINATION OR EXPLOSIVE SAFETY. BOTH THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE LAUNCH VEHICLE PROGRAMS ARE SUBJECT

TO EASTERN AND WESTERN RANGE RULE NUMBER 127-1 RANGE SAFETY REQUIREMENTS. THIS REGULATION ADDRESSES ALL ASPECTS OF RANGE SAFETY, AND SPECIFIES THE SAFETY AND PLANNING REQUIREMENTS THAT ALL LAUNCH PROGRAMS ON THE EASTERN AND WESTERN RANGES MUST ADHERE TO.

AMONG OTHER REQUIREMENTS, THESE PROCEDURES REQUIRE MONITORING METEOROLOGICAL CONDITIONS UP TO THE TIME OF LAUNCH TO ENSURE THAT THE LAUNCH WILL NOT POSE A SAFETY RISK TO BASE PERSONNEL OR THE GENERAL PUBLIC. THE RANGE COMMANDER USES THIS INFORMATION TO DECIDE WHETHER TO PROCEED WITH THE LAUNCH OR CANCEL IT OR DELAY.

THE TYPES OF HAZARDOUS MATERIALS USED AND WASTES GENERATED AT THE TWO INSTALLATIONS UNDER THE PROPOSED ACTION WOULD BE SIMILAR TO THOSE GENERATED UNDER THE NO-ACTION ALTERNATIVE.

THE TYPES OF HAZARDOUS WASTES GENERATED DURING PROCESSING AND LAUNCH PROPOSED ACTION VEHICLES WOULD BE COMPARABLE TO THE TYPES OF WASTE GENERATED UNDER THE NO-ACTION VEHICLES, BUT THE QUANTITIES WOULD BE GREATER. WITH THE INCREASED LAUNCH RATE AND THE USE OF LARGER AND ADDITIONAL SRM'S, TOTAL ESTIMATED HAZARDOUS WASTES GENERATED ON A YEARLY BASIS WOULD BE GREATER UNDER THE PROPOSED ACTION THAN UNDER THE NO-ACTION ALTERNATIVE.

THE USE OF HAZARDOUS MATERIALS AND THE DISPOSAL OF HAZARDOUS WASTES ASSOCIATED WITH THE EELV PROGRAM WOULD COMPLY WITH ALL APPLICABLE STATE AND

FEDERAL REGULATIONS.

GROUND DISTURBANCE ASSOCIATED WITH FACILITY CONSTRUCTION, RENOVATIONS, DEMOLITION, AND INFRASTRUCTURE IMPROVEMENTS FOR THE PREVIOUSLY ANALYZED EELV PROGRAM WAS ADDRESSED IN THE 1998 FEIS. IMPLEMENTATION OF STANDARD CONSTRUCTION PRACTICES FOR HIGHLY ERODIBLE SOILS WILL MINIMIZE POTENTIAL EROSION IMPACTS WITH THOSE CONSTRUCTION ACTIVITIES.

UNDER THE PROPOSED ACTION INCREASED WATER REQUIREMENTS ARE WITHIN CAPACITY OF THE LOCAL PURVEYORS.

UNDER THE NO-ACTION ALTERNATIVE, CONSTRUCTION-RELATED GROUND DISTURBANCE EXCEEDS FIVE ACRES AT BOTH INSTALLATIONS. CONSEQUENTLY THEY ARE BOTH SUBJECT TO NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM OR NPDES PERMIT REQUIREMENTS TO REDUCE RUNOFF TO WATERS TO THE UNITED STATES. ADHERENCE TO PERMIT REQUIREMENTS AND STANDARD CONSTRUCTION PRACTICES ARE EXPECTED TO MINIMIZE ANY POSSIBLE IMPACTS TO SURFACE WATERS DURING THE CONSTRUCTION OF THE EELV FACILITIES. THE INCREASED WATER USAGE FOR LAUNCH PAD DELUGE AND WASHDOWN OF THE ATLAS V VEHICLE IS NOT EXPECTED TO ADVERSELY IMPACT LOCAL WATER RESOURCES. WATER USAGE ASSOCIATED WITH THE EELV SYSTEMS IS NOT EXPECTED TO AFFECT GROUNDWATER RESOURCES IN EITHER AREA.

IMPACTS TO LOWER ATMOSPHERE AIR QUALITY ASSOCIATED WITH THE EELV PROGRAM WOULD BE DUE TO AIR

EMISSIONS RESULTING FROM THE CONSTRUCTION OF LAUNCH SUPPORT FACILITIES, EMISSIONS FROM THE OPERATION OF MOTOR VEHICLES AND FACILITIES, AND DIRECT EMISSIONS FROM THE LAUNCH VEHICLES THEMSELVES. ALL OF THESE EMISSIONS HAVE BEEN CONSIDERED IN THE ANALYSIS OF AIR QUALITY FOR THIS PROGRAM. COMPUTATIONS INDICATE THAT EELV PROGRAM WILL NOT JEOPARDIZE THE ATTAINMENT STATUS FOR CRITERIA POLLUTANTS AT EITHER INSTALLATION.

CAPE CANAVERAL IS LOCATED IN BREVARD COUNTY, FLORIDA, WHICH IS CURRENTLY IN ATTAINMENT OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR ALL OUR CRITERIA POLLUTANTS. THE SHORT TERM CONSTRUCTION EMMISSIONS FOR THE NO-ACTION ALTERNATIVE ACCOUNTS FOR LESS THAT 0.5 PERCENT OF BREVARD COUNTY'S EMISSIONS IN ANY ONE YEAR AND WOULD NOT JEOPARDIZE BREVARD COUNTY'S ATTAINMENT STATUS.

VANDENBERG AIR FORCE BASE IS LOCATED IN SANTA BARBARA COUNTY, CALIFORNIA, WHICH HAS BEEN DESIGNATED BY THE U.S. EPA AS BEING IN SERIOUS NONATTAINMENT OF THE NATIONAL AMBIENT AIR QUALITY STANDARD FOR OZONE. DUE TO THE COUNTY STATUS WE ALSO CONSIDERED HOW IMPLEMENTATION OF EELV SYSTEMS WOULD IMPACT THE STATE'S IMPLEMENTATION PLAN OR SIP FOR ATTAINING THE OZONE NATIONAL AMBIENT AIR QUALITY STANDARD FOR SANTA BARBARA COUNTY. TOTAL PEAK YEAR OPERATION AND CONSTRUCTION EMISSIONS FOR THE EELV PROGRAM ARE WELL BELOW THE 50-TON DE MINIMIS THRESHOLD FOR OZONE PRECURSORS WHICH ARE VOLITILE COMPONENTS AND

[illegible]

[illegible]

SONIC BOOMS.

AT VANDENBERG, SONIC BOOMS OCCUR SOUTH OF VANDENBERG AIR FORCE BASE ALONG THE VEHICLE'S LAUNCH TRAJECTORY. BOOMS ARE GENERALLY 20 MILES OFF SHORE AND IN SOME CASES IMPACT THE UNPOPULATED CHANNEL ISLANDS. NO ADVERSE IMPACTS TO THE PUBLIC OR HISTORIC STRUCTURES ARE EXPECTED.

THE NO-ACTION ALTERNATIVE WILL ADD SMALL INCREMENTAL AMOUNTS TO THE EXISTING ORBITAL DEBRIS POPULATION ORBITING THE EARTH. HOWEVER, THESE ADDITIONS WILL BE MINIMIZED THROUGH THE USE OF DESIGNS WHICH MINIMIZE ON-ORBIT EXPLOSIONS AND RESULTANT SCATTERING OF SMALL PIECES OF HARDWARE.

UNDER THE PROPOSED ACTION, GIVEN THE INCREASED EELV PROGRAM LAUNCH RATE THERE WOULD BE A NOMINAL INCREASE IN ORBITAL DEBRIS FROM DOMESTIC VEHICLES. HOWEVER, OVERALL THERE WOULD BE NO SIGNIFICANT GLOBAL EFFECTS.

AT CAPE CANAVERAL: UNDER THE PROPOSED ACTION, INCREASED LAUNCH RATES WOULD CAUSE INCREASED FREQUENCY OF LAUNCH NOISE AND ASSOCIATED TEMPORARY STARTLE DISTURBANCES OF LOCAL SPECIES. THE EFFECTS OF ACID DEPOSITION FROM THE SRM'S ON LOCAL FLORA AND FAUNA ARE EXPECTED TO BE MINIMAL. LARGER AND MORE FREQUENT HYDROGEN CHLORIDE GROUND CLOUDS FROM THE INCREASED USE OF SRM'S WOULD TEMPORARILY AFFECT FLORA AND FAUNA AROUND SLC-37 AND SLC-41.

UNDER THE NO ACTION ALTERNATIVE, IDENTIFIED MITIGATIONS FOR POTENTIAL IMPACTS TO WETLANDS AND THREATENED AND ENDANGERED SPECIES DUE TO LAUNCH AND CONSTRUCTION ACTIVITIES WOULD CONTINUE TO BE IMPLEMENTED. IMPACTS TO WILDLIFE WILL BE MINIMAL AND ARE PRIMARILY DUE TO PRE-FLIGHT OVERFLIGHTS AND NOISE AND HEAT FROM LAUNCHES.

AT VANDENBERG UNDER THE PROPOSED ACTION, LAUNCHES WOULD CAUSE LAUNCH NOISE IN ASSOCIATED TEMPORARY STARTLE DISTURBANCES OF LOCAL SPECIES. SONIC BOOMS OVER THE CHANNEL ISLANDS WOULD TEMPORARILY STARTLE MARINE MAMMALS.

THE EFFECTS OF ACID DEPOSITION ON LOCAL FLORA AND FAUNA ARE EXPECTED TO BE MINIMAL. PLANT SPECIES ARE EXPECTED TO RECOVER FROM SHORT TERM LAUNCH IMPACTS. LARGER AND MORE FREQUENT HYDROGEN CHLORIDE GROUND CLOUDS WOULD RESULT FROM THE INCREASED USE OF SRM'S, TEMPORARILY AFFECTING FLORA AND FAUNA AROUND SLC-3 WEST AND SLC-6.

UNDER THE NO-ACTION ALTERNATIVE, THE EFFECTS OF ACID DEPOSITION ON LOCAL FLORA AND FAUNA ARE EXPECTED TO BE MINIMAL DUE TO THE LESSER USE OF SRM'S. STARTLE EFFECTS DUE TO NOISE AND SONIC BOOM WOULD CONTINUE TO EFFECT SPECIES ON THE MAINLAND AND CHANNEL ISLANDS. SECTION 7 CONSULTATION UNDER THE ENDANGERED SPECIES ACT IS UNDERWAY WITH THE U.S. FISH AND WILDLIFE SERVICE FOR THE NO-ACTION ALTERNATIVE AND WILL ALSO INCORPORATE THE CURRENT PROPOSED ACTION.

UNDER THE PROPOSED ACTION NO ADDITIONAL

CONSTRUCTION [illegible] IS [illegible] AT EITHER LOCATION.

UNDER THE NO-ACTION ALTERNATIVE, NO IDENTIFIED ARCHAEOLOGICAL SITES ARE WITHIN THE AREAS OF DISTURBANCE AT EITHER INSTALLATION. IN AUGUST OF [illegible], THE AIR FORCE EXECUTED A MEMORANDUM OF AGREEMENT WITH THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICE THAT ADDRESSES THE CONTINUING TREATMENT OF HISTORIC PROPERTIES AT SLC-[illegible] AT VANDENBERG. ARCHAEOLOGICAL AND NATIVE AMERICAN MONITORING IS REQUIRED AT SLC-[illegible] AT VANDENBERG AIR FORCE BASE TO [illegible] IDENTIFIED [illegible] ARCHAEOLOGICAL SITES. ACTIVITIES AT CAPE CANAVERAL HAVE BEEN DETERMINED TO HAVE NO ADVERSE EFFECT ON ANY HISTORIC FACILITIES AT THAT LOCATION.

THERE IS NO CHANGE TO THE ENVIRONMENTAL ANALYSIS FOR THE PROPOSED ACTION SINCE THE FEIS WAS COMPLETED.

UNDER THE NO-ACTION ALTERNATIVE IMPLEMENTATION OF THE NO-ACTION ALTERNATIVE WILL HAVE NO DISPROPORTIONATELY ADVERSE IMPACTS ON LOW-INCOME AND MINORITY POPULATIONS IN THE VICINITY OF CAPE CANAVERAL OR VANDENBERG AIR FORCE BASE.

AND THIS CONCLUDES MY COMMENTS. I [illegible] [illegible], THAT CONCLUDES THE PRESENTATION OF THE DRAFT SEIS RESULTS. IN CLOSING, AND I WOULD LIKE TO REMIND YOU THAT WE ARE HERE THIS EVENING TO GET YOUR INPUT TO THE ENVIRONMENTAL IMPACT ANALYSIS PROCESS, AND SPECIFICALLY TO HEAR YOUR INPUT ON THE DRAFT SEIS. WE

WILL BE ACCEPTING WRITTEN COMMENTS THROUGH [illegible] 27 AT THE ADDRESS SHOWN ON THIS SLIDE. ALL COMMENTS RECEIVED WILL BE CONSIDERED IN PREPARATION OF THE FINAL SEIS. THANK YOU.

COL. [illegible]: THANK YOU MR. CLARK. FOLKS, NOW WE WILL TAKE A SHORT BREAK, AND AFTER THE BREAK WE WILL RECONVENE TO OPEN UP THE MEETING TO ANYONE WHO WOULD LIKE TO MAKE COMMENTS. IF YOU DO WISH TO SPEAK TONIGHT AND YOU HAVE NOT YET FILLED OUT A REGISTRATION CARD, PLEASE DO SO AT THIS TIME SO I KNOW THAT YOU WANT TO SPEAK. ONCE YOU HAVE COMPLETED THE CARD TURN IT IN AT THE REGISTRATION TABLE. AS I SAID EARLIER, ELECTED OFFICIALS WILL BE ALLOWED AN OPPORTUNITY TO SPEAK FIRST, AND THEN ALL OTHER SPEAKERS WILL BE CALLED ON FROM THE CARDS THAT I COLLECT.

LET'S TAKE ABOUT TEN MINUTES AND WE WILL RECONVENE.

(A BREAK WAS TAKEN.)

COL. [illegible]: IF I CAN PLEASE ASK EVERYONE TO COME IN AND HAVE A SEAT. WE ARE NOW GOING TO START THE MAIN PORTION OF THE MEETING WHICH IS THE PUBLIC COMMENT PERIOD. IF YOU DO CHOOSE TO SPEAK TONIGHT, PLEASE COME UP TO THE PODIUM HERE WHERE WE HAVE A MICROPHONE SO EVERYONE CAN HEAR YOU. I ASK THAT YOU STATE YOUR NAME AND ADDRESS BEFORE BEGINNING YOUR COMMENTS. ALSO SPEAK CLEARLY AND DIRECT YOUR COMMENTS TO ME. IN ADDITION IF YOU ARE REPRESENTING A SPECIFIC

GROUP, PLEASE IDENTIFY THE GROUP BY NAME. AS YOU CAN SEE WE DO HAVE A COURT REPORTER HERE WHO IS TAKING DOWN EVERYTHING THAT IS BEING SAID AND THAT WILL BECOME PART OF THE OFFICIAL TRANSCRIPT OF THE MEETING AND PART OF THE RECORD THAT IS DONE FOR THIS PROCEEDING. THE RECORD WILL ENSURE THAT THE RESEARCHERS WILL BE ABLE TO IDENTIFY SIGNIFICANT ISSUES IN YOUR ORAL PRESENTATIONS SO THAT THEY CAN BE ADDRESSED IN THE FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT. WRITTEN COMMENTS WILL ALSO BECOME PART OF THE RECORD AND WILL RECEIVE EQUAL CONSIDERATION.

I RECEIVED TWO CARDS INDICATING THAT TWO PEOPLE DESIRE TO SPEAK AT THIS POINT. FIRST ONE SUBMITTED WAS FROM JUSTIN RUHGE. I HOPE I PRONOUNCED THAT CORRECTLY.

MR. RUHGE: THANK YOU, INTERESTING SO FEW THAT WANT TO SPEAK. MY NAME IS JUSTIN RUHGE, I AM HERE TONIGHT REPRESENTING THE SANTA BARBARA COUNTY TAX PAYERS ASSOCIATION. WE HAVE AN ASSOCIATION WITH ABOUT A THOUSAND MEMBERS ACROSS THE COUNTY OF SANTA BARBARA AND WE ARE INTERESTED IN BETTER GOVERNMENT, MORE EFFICIENT GOVERNMENT, AND LOWER COST GOVERNMENT, AND LOWER TAXES. AND THE REASON WE ARE HERE IS JUST TO THANK YOU TONIGHT AFTER LISTENING TO YOUR PRESENTATION, THANK YOU FOR TAKING THE TIME TO COME HERE AND GIVE US A PRESENTATION. WE REALIZE IT IS COSTING US TAX PAYERS A LOT OF MONEY TO DO THIS,

HOWEVER, WE WANT TO SEE THAT THE ENVIRONMENT IS CONSIDERED IN YOUR DELIBERATIONS. THE THING THAT WE DEFINITELY WANT TO SEE IS THAT IT IS NOT OVER CONSIDERED. WE FIND THAT A LOT OF THINGS GOING ON TODAY SEEM TO PUT TOO MUCH EMPHASIS ON ENVIRONMENT.

IN THE CASE OF VANDENBERG AIR FORCE BASE WE HAVE BEEN LAUNCHING ROCKETS HERE FOR THE LAST 40 YEARS, THERE HAS NEVER BEEN A PROVEN EFFECT ON THE ENVIRONMENT WHICH HAS BEEN PUBLISHED, AND WE WOULD LIKE TO POINT THAT OUT. WE WOULD LIKE TO RECOMMEND THAT YOU TAKE A MIDDLE COURSE AND CONSIDER THE ENVIRONMENTAL ASPECTS OF YOUR NEW LAUNCH VEHICLE, WHICH I HAVE TRACKED FOR THE LAST FEW YEARS AS AN AEROSPACE ENGINEER AND -- BUT LET'S NOT LET IT HAVE IT

10-1 TAKEN OUT OF CONTEXT WITH WHAT WE ARE TRYING TO DO. WE HAVE SEEN ONE PROJECT HERE PRESENTED BY THE AIR FORCE IN WHICH ALL THEY HAVE TO DO IS CLEAN OUT SOME WILLOWS AND CLEAN OUT A CREEK TO SOLVE A PROBLEM THEY HAVE OUT HERE IN THE AIR FORCE BASE, YET THEY ARE TALKING ABOUT SPENDING UP TO TEN MILLION DOLLARS TO BUILD A CAUSEWAY, AND WE FEEL THIS IS SO THAT YOU WON'T HAVE TO CLEAN OUT THE CREEK.

WE FEEL THERE IS SOME EXCESSIVE CONSIDERATIONS FOR ENVIRONMENT. WE HAVE SEEN OUR BRIDGE OVER HERE ON 246 GO OUT. IT HAS NOTHING TO DO WITH THE AIR FORCE, I KNOW, BUT THE BIG DELAY IN FIXING THE BRIDGE AND GETTING IT GOING WAS BECAUSE OF ENVIRONMENTAL CONSIDERATIONS, AND YET WE LOST HUNDREDS

[illegible]

[illegible]

A NUMBER OF OTHER CONDITIONS, FEMALE REPRODUCTIVE CANCER, HIGH RATES OF BREAST CANCER AND SOME OTHER PROBLEMS IN LOMPOC THAT HAVE BEEN DOCUMENTED IN VARIOUS STUDIES.

THE BRONCHITIS IN LOMPOC IS NOW, IN THE LATEST STUDY BY THE OFFICE OF ENVIRONMENTAL HEALTH ASSESSMENT, AND THIS WAS ALL DONE BY THE STATE OF CALIFORNIA. THIS AGENCY HAS SHOWN THAT WE HAVE THE WORST INCIDENTS OF BRONCHITIS IN ALL OF CALIFORNIA EXCEPT FOR LOS ANGELES, WHO WE ARE ON PAR WITH. PRETTY CLEARLY WE HAVE AN ENVIRONMENTAL PROBLEM IN OUR AREA OR YOU WOULDN'T HAVE SUCH BRONCHITIS PROBLEMS. SO MY CONCERNS TODAY DIRECTLY RELATE. AMONG OTHER THINGS IT DISTURBS ME, FOR EXAMPLE, JUST TO MENTION A FEW OTHER THINGS THAT YOU MENTIONED IN YOUR ANNUAL GLOBAL OZONE WOULD INCREASE THREE TIMES MORE WITH THIS ACTION THEN WITH THE NO-ACTION ALTERNATIVE.

10-3 ALSO I AM CONCERNED ABOUT POSSIBLE WATER RUNOFF TO THE OCEAN. I DON'T KNOW IF THAT WAS ADDRESSED OR NOT, IF SO I MISSED IT.

10-4 AND THEN THAT ACID DEPOSITION, HOW LONG WOULD THERE BE SMALL CANYONS AFFECTED AND WILDLIFE IN THOSE AREAS. BUT THOSE ARE ALL CONCERNS,

10-5 BUT I WANT TO STICK WITH MY NUMBER ONE CONCERN IS AIR QUALITY IN LOMPOC ITSELF. AND THE LAST PERSON THAT WAS UP HERE AT THE PODIUM MENTIONED THAT THESE ARE DIRTIER ROCKETS. I THINK THIS IS OF CONCERN. I DON'T KNOW IF YOU ARE DOING JUST MODELING, WHAT ARE YOU DOING TO DETERMINE HOW THESE POLLUTANTS REACH THE VALLEY AND, IF THEY DO OR NOT THAT WOULD BE A QUESTION, AN IMPORTANT QUESTION. IS THERE ANY KIND OF MONITORING?

NOW, I KNOW THAT THE BASE DID HAVE RELEASES IN THE EARLY 90'S AND POSSIBLE A FEW YEARS BEFORE OF HOFLURONLEX (PHONETIC) FLORIDE, WHICH IS A TRACE ELEMENT, AND THAT WAS RELEASED FAR TO THE WEST OF LOMPOC RIGHT ABOUT WHERE THE BASE IS, THE FAR WEST OF LOMPOC AND THAT WAS FOUND IN LOMPOC EVERY TIME THAT IT WAS RELEASED OUT THERE. SO, IN OTHER WORDS, POLLUTION FROM FAR WEST DOES REACH LOMPOC AND I WOULD LIKE TO KNOW IF IN ANY WAY THAT IS GOING TO BE IMPACTING NEGATIVELY OUR AIR IN LOMPOC. IT IS A VERY GREAT CONCERN IF IT IS.

10-6 I HAVE ONE QUESTION, VERY SIMPLY HERE IS SOMETHING I HAVE BEEN MIXED UP ON, HOW MANY MISSILES ARE ALL TOGETHER ARE BEING SENT OFF AT THE BASE NOW? HOW MANY UNDER THE ONE PROPOSAL AND HOW MANY UNDER THIS SECOND PROPOSAL? CAN ANYBODY ANSWER THAT RIGHT NOW? TOTAL, I MEAN, INCLUDING ALL THESE PROGRAMS?

LT. COL. ODLE: DO YOU MEAN INCLUDING THE PROGRAMS THAT ARE CURRENTLY FORMED THERE AS WELL?

MR. RORH: RIGHT.

LT. COL. ODLE: I DON'T HAVE THAT INFORMATION HERE. WE WOULD HAVE TO GET THAT. WE CAN CERTAINLY ANSWER THAT QUESTION AS WE ANSWER THE OTHER QUESTIONS AND ISSUES THAT YOU HAVE BROUGHT UP.

10-7

[illegible]

10-8

[illegible]

[illegible]

10-9

[illegible]

TAILPIPE, BASICALLY, BUT OF THE LAUNCH VEHICLES THAT YOU ARE LOOKING AT HERE. I MEAN ONES BASIC BOOSTER LIQUID OXYGEN, LIQUID HYDROGEN, THERE IS NOT REALLY ANYTHING THERE IN POLLUTANTS, AND THE OTHER IS KEROSENE AND LIQUID OXYGEN. SO THE BASIC BOOSTERS ACTUALLY DON'T HAVE A WHOLE LOT OF UNUSUAL HAZARDOUS AIR POLLUTANTS THAT I THINK YOU MIGHT BE CONCERNED ABOUT. THE CHANGE HERE, OBVIOUSLY, IS THAT WE ARE NOW LOOKING AT SOLID ROCKETS THAT ARE STRAPPED ONTO THESE, AND WE HAVE ADDRESSED THE EMISSIONS FROM THOSE AS WELL.

MR. RORH: THOSE ARE MORE PROBLEMATIC YOU ARE SAYING?

MR. CLARK: I AM NOT SAYING THEY ARE MORE PROBLEMATIC, I AM SAYING THIS IS THE CHANGE. THAT IS THE THING WE WERE LOOKING AT IN THE SUPPLEMENTAL SEIS THAT THEY ARE BASED ON THE STRAP-ON SOLID ROCKETS.

MR. RORH: COMPOUNDS, WOULD THAT MEAN THAT WOULD BE AIRBORNE NOW?

MR. CLARK: I PROBABLY NEED TO DO SOME FURTHER -- I NEED TO PULL OUT SOME INFORMATION FOR THIS, BUT ONE OF THE CHIEF AREAS OF CONCERN IS THE HYDROGEN CHLORIDE CLOUD THAT IS FORMED FROM THE LAUNCH OF THOSE.

MR. RORH: RIGHT. OKAY, WELL WE WOULD LIKE TO SEE THAT THIS IS SOMETHING THAT IS GOING TO BE ADDRESSED VERY CAREFULLY. WHEN THAT TITAN BLEW UP HERE IN THE LATE '80'S WAS IT, WAS THERE A HYDROGEN CHLORIDE CLOUD THAT WAS FORMED THEN? DOES ANYBODY REMEMBER?

LT. COL. ODLE: YOU ARE TALKING ABOUT AN OLD TITAN 4D, I BELIEVE, 34D-9 THAT ACTUALLY BLEW UP BACK IN 1986, IF MEMORY SERVES.

MR. RORH: RIGHT.

LT. COL. ODLE: THAT VEHICLE FLEW WITH SOLID ROCKETS, MORE MOTOR, HUGE SOLID ROCKET MOTOR TO WHAT WE ARE SPEAKING ABOUT HERE, SO YOU GOT ALL SORTS OF EMISSIONS. THEY USED A HYPERCOLIC (PHONETIC) FUEL, WHICH IS DIFFERENT THAN THE MORE REFINED FUELS IN THE CORE VEHICLE THAT WE ARE TALKING ABOUT HERE. AND THEY ALSO USED SOLID ROCKET MOTORS SIMILAR TO THE ONES WE ARE USING HERE EXCEPT THEY WERE STEEL MADE INSTEAD OF GRAPHITE EPOXY MOTORS, SO YOU WOULD GET A SIGNIFICANT EMISSION FROM A TITAN 4 DETONATING, ONE DETONATING WAS 800 FEET OR SO ABOVE GROUND, SO YOU GOT A LOT OF VERY CONCENTRATED VERY LOCAL.

10-10 MR. RORH: WHAT ABOUT IF ONE OF THESE DETONATES THEN?

LT. COL. ODLE: WELL, THERE IS ALWAYS THE POSSIBILITY THAT THAT COULD HAPPEN, BUT THE SYSTEM RELIABILITY FOR THESE -- ONE OF THE REASONS WE BUILT THESE IS BECAUSE THEY ARE MUCH LESS COMPLEX SYSTEMS AND WE THINK WILL BE MUCH MORE RELIABLE, SO YOU WOULD EXPECT TO SEE A MUCH HIGHER EMISSION SUCCESS RATE, BUT YOU WOULD HAVE SOME EMISSIONS IF YOU HAD A CATASTROPHIC FAILURE IN THE SAME WAY IF YOU HAD A

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IN RE: PUBLIC HEARING
DSEIS FOR IMPLEMENTATION OF EELV PROGRAM

ORIGINAL

11

TRANSCRIPT OF PROCEEDINGS

The transcript of the proceedings held at the public hearing held for presentation of the DSEIS for implementation of the EELV Program on December 7, 1999, at the Radisson Resort and Conference Center, 8701 Astronaut Boulevard, Cape Canaveral, Florida, commencing at 7:00 p.m.

REPORTED BY: DEBRA M. ARTER, REGISTERED DIPLOMATE REPORTER

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A P P E A R A N C E S

COLONEL MICHAEL B. McSHANE
Chief Trial Judge
United States Air Force Trial Judiciary
Bolling Air Force Base, DC

LIEUTENANT COLONEL ROGER ODLE
Chief of Launch Site Activation and Operations
EELV Program Office
Los Angeles Air Force Base
Los Angeles, California

DALE CLARK
Environmental Project Manager
Air Force Center for Environmental Excellence
Brooks Air Force Base
San Antonio, Texas

* * * * *

I N D E X

[illegible]

[illegible]

you'll also hear that tonight, and Air Force implementing regulations.

The purpose of this hearing is to summarize for you the results of the Draft SEIS and to receive your comments on the Draft SEIS.

Tonight's hearing will be in two parts. In the first part, Colonel Odle and Mr. Clark will present information to you concerning the environmental impact analysis performed for the program.

The second part of the hearing is the public participation portion where you will have the opportunity to comment on the Draft SEIS.

This hearing is intended to provide a public forum for two-way communication about the Draft SEIS with a view to improving the decision-making process. Your inputs will ensure that the decision-makers have the benefit of your knowledge of the local area and any adverse environmental effects that you think may result from the proposed action or alternative.

Let me tell you what the hearing is

not. It is not a debate, nor is it a referendum. It is also not a vote on the actions that have been analyzed in the Draft SEIS.

The focus of the hearing is on the environmental impacts associated with the proposals being studied by the Air Force. Comments on non environmental issues should not be raised at this hearing.

Moreover, none of the panel members are the Air Force decision-makers on this project.

When you came in tonight, you were provided with an attendance card that looks like this. You were asked to fill it out and indicate on it whether you wish to speak tonight.

After the presentations by Colonel Odle and Mr. Clark, we will take a short break. Following that break, you will have an opportunity to speak, ask clarifying questions, or both. If we have any elected public officials here, they will be called on first, followed by members of the public.

If you have not had an opportunity to

[illegible]

[illegible]

This overview will describe the Proposed Action and the No-Action Alternative, which was essentially the Proposed Action approved in the 1998 Final EIS.

The U.S. Air Force is implementing the development and deployment of an evolved expendable launch vehicle, or EELV. The EELV system is a partnership with private industry, in this case two separate partnerships with Lockheed Martin Astronautics Corporation and the Boeing Company, to develop a national launch capability that satisfies the Government's national launch forecast requirements and reduces the cost of space launch by at least 25 percent.

The EELV system is also expected to increase U.S. industry's competitiveness in the international space launch market.

The EELV Program is a family of unmanned expendable space launch vehicles evolved from existing systems. The EELV will ultimately be the Department of Defense's sole source of expendable medium- and heavy-lift transportation to orbit. It will also be capable of launching civil,

which includes the National Aeronautics and Space Administration, or NASA, and other Government satellites.

The EELV will also launch commercial satellites. Each contractor's EELV Program currently consists of a family of medium-launch vehicles, MLVs, and heavy-launch vehicles launched from their own launch complexes at Cape Canaveral Air Force Station and Vandenberg Air Force Base.

EELV flights will begin in the year 2001 and continue through the year 2020. Construction necessary to implement the program was approved in the FEIS and has already begun at both bases. The EELV program will ultimately replace current Atlas, Delta and Titan launch vehicles currently flown from Cape Canaveral Air Station and Vandenberg Air Force Base.

The Draft SEIS describes the proposed changes from the 1998 Final EIS that was allowed for implementation when the Record of Decision was signed by the Air Force on June 8, 1998. Lockheed Martin proposes to add up to five strap-on solid rocket motors,

[illegible]

[illegible]

case and propellant mixture consisting of, again, ammonium perchlorate aluminum and an organic binding agent. Again, some existing structures would be modified slightly, but no ground-disturbing construction will occur at either launch site as a result of this Proposed Action.

The Air Force will continue to implement the medium- and heavy-lift EELV program implemented when the Record of Decision for the FEIS was executed on June 8, 1998. This No-Action Alternative will continue whether or not the Proposed Action is approved.

Subsequent to the preparation of the 1998 FEIS, launch projections over the 20-year planning period using vehicle configurations considered in that document changed as a result of updates in the Air Force Space Command's National Launch Forecast, which is the long-range planning document for all Government missions, and the Department of Commerce's Commercial Space Transportation Advisory Committee's Launch Forecast, which is the

long-range planning document for all commercial space launch missions.

The 1998 FEIS projected a total of 534 EELV launches over the 20-year period at both launch bases. That figure has been revised downward to 472 launches for the No-Action Alternative in this SEIS. The Proposed Action would launch 566 EELV vehicles over the same 20-year period.

Ladies and Gentlemen, that's where the EELV Program stands today. Any additional significant EELV Program design or operational changes which could result in environmental impacts will be addressed in accordance with the environmental impact analysis process.

Now I'll turn the floor over to Mr. Clark, who will discuss the environmental impact analysis process and the Draft SEIS results.

MR. CLARK: Thank you, Colonel Odle. My name is Dale Clark and I am an Environmental Project Manager with the Air Force Center for Environmental Excellence which is located at Brooks Air Force Base in Texas. The EELV Program Office used our organization to

[illegible] the previous 1998 FEIS by [illegible] the current Supplemental Environmental Impact Statement that we're looking at tonight.

The independent environmental consultant that assisted in preparation of the Draft SEIS is [illegible]. Tonight I'm going to provide some background on the environmental impact analysis process generally and then discuss the Draft SEIS that has been prepared for the program.

The National Environmental Policy Act, or NEPA, requires that federal agencies consider the environmental consequences of their proposed actions in their decision-making process. The Air Force decision under [illegible] is whether to allow implementation of the proposed revisions to the existing EELV Program at Cape Canaveral Air Station and at Vandenberg Air Force Base. We are preparing this SEIS to analyze the potential environmental consequences of such revisions.

Due to the [illegible] of potential commercial launch activities, the FAA is serving as a cooperating agency in the preparation of the SEIS, as is NASA.

NEPA also requires that the public be involved in this decision-making process. We published a Notice of Intent to prepare the SEIS in the Federal Register on April [illegible], 1999, and conducted scoping during April and May of this year. The notice described the proposed revisions to the existing EELV Program and it requested public input on the issues to be addressed.

The scoping process helped guide the preparation of the Draft SEIS. The Draft SEIS was made available for public review and comment beginning in November of this year.

Tonight's public hearing is a formal meeting at which we review the results presented in the Draft SEIS and receive your comments on the document.

Any comments made on the Draft SEIS this evening, whether verbal or written, will be part of the public record and will be considered as we prepare the Final Supplemental Statement. Written comments will be accepted throughout the public comment period as described by Colonel [illegible], which lasts until December 27th.

After the end of the public comment period, all public comments will be reviewed, responses will be prepared and the SEIS may be revised, if necessary. All comments received will be printed in the Final SEIS which is scheduled for publication in March of 2000.

Following release of the Final SEIS and a required 30-day waiting period, the Air Force may publish its Record of Decision indicating its decision on allowing implementation of the proposed EELV revisions.

The three major portions of an EIS, supplemental or otherwise, are the description of alternatives, including the Proposed Action and No-Action Alternative, presented in Chapter Two, the description of the affected environment presented in Chapter Three, and the environmental consequences or impacts of implementing the alternatives, which is presented in Chapter Four.

Chapter Two, the description of alternatives including the Proposed Action, is the heart of the EIS. It explains the activities that are being proposed. As already described by Colonel Odle, the Proposed Action in the Draft SEIS is

to add up to five SRMs to Lockheed's Atlas V medium-launch vehicle and to add two to four SRMs to Boeing's Delta IV medium-launch vehicle that are larger than those analyzed in the 1998 FEIS.

Under the No-Action Alternative, the EELV Program that was allowed for implementation with the Record of Decision in June of '98 will continue to be implemented.

The No-Action Alternative and the current SEIS is essentially the same as Concept A/B of the Proposed Action in the 1998 FEIS.

If these new proposed actions are not accepted, Boeing and Lockheed Martin would simply continue to construct and operate their systems under the parameters of the 1998 FEIS. No SRMs could be used with the Atlas V medium-launch vehicle and larger SRMs could not be used with the Delta IV medium-launch vehicle.

Chapter Three of the SEIS describes the affected environment. It describes a description of the existing conditions in the project area prior to implementing the Proposed Action and serves as a baseline for assessing

[illegible]

[illegible]

when I refer to the No-Action Alternative, I am referring to the ongoing implementation of the EELV Program as it was proposed in the 1998 FEIS except for the changes in launch rates as described by Colonel Odle earlier.

Now I'll discuss the individual issue areas.

Under the Proposed Action, program employment levels at full operation are projected to remain essentially the same as those forecast for the No-Action. Under both the Proposed Action and the No-Action Alternative, increases in direct employment are forecast during construction activities for the EELV Program that were analyzed in the FEIS. Reductions in employment are projected as the EELV Program is implemented and existing vehicles are phased out.

Proposed land uses under the Proposed Action as well as the No-Action Alternative at both installations are generally compatible with existing land use in the surrounding areas and with regional land use plans. Due to the location of all proposed launch activities within the coastal zone, coastal

zone consistency determinations were prepared by the Air Force for submission to the appropriate state agencies for the 1998 FEIS in accordance with the Coastal Zone Management Act.

The current Proposed Action has been determined by the Air Force to be essentially equivalent to the No-Action Alternative with respect to potential impact to the coastal zone.

Under the Proposed Action, transportation conditions remain essentially the same as those forecast for the No-Action Alternative. Under both the Proposed Action and the No-Action Alternative, updated launch pad deluge water requirements for the Atlas V vehicle will generate additional truck trips to dispose of wastewater at Vandenberg Air Force Base. The Proposed Action also requires a small increase in the number of truck trips for the delivery of the SRMs themselves.

However, these additional truck trips are not sufficient to change the level of surface on local roads at either location.

Temporary increases in traffic around the

[illegible]

[illegible]

waste generated under the No-Action but the quantities would be different.

With the increased launch rate at Cape Canaveral and the use of larger and additional SRMs, total estimated hazardous wastes generated on a yearly basis would be greater under the Proposed Action than under the No-Action Alternative. The use of hazardous materials and the disposal of hazardous wastes associated with the EELV program would comply with all applicable state and federal regulations.

Ground disturbance associated with facility construction, renovations, demolition and infrastructure improvements for the previously analyzed EELV Program were addressed in the '98 FEIS. Implementation of standard construction practices for highly erodible soils will minimize potential erosion impacts.

Under the Proposed Action, increased water requirements are within the capacity of local purveyors. Under the No-Action Alternative, construction-related ground disturbance is expected to exceed, well, will exceed five acres at both installations. Consequently,

they are both subject to national pollutant discharge elimination system permit requirements to reduce runoff to waters of the United States. Adherence to these permit requirements and standard construction practices are expected to minimize any possible impacts to surface waters during construction of the EELV facilities.

The increased water usage for launch pad water deluge washdown of the Atlas V vehicle is not expected to adversely impacted local water resources. Water usage associated with EELV systems is not expected to affect groundwater resources in either area.

Impacts to lower atmosphere air quality associated with the EELV Program would be due to air emissions resulting from the construction of launch and support facilities, emissions from the operation of motor vehicles and facilities and direct emissions from the launch vehicles themselves. All of these emissions have been considered in the analysis of air quality for this program, both in the previous FEIS as well as in this document.

Computations indicate that the EELV

[illegible]

[illegible]

and are somewhat less than the estimated 80 -- 80 to 85 decibels produced by the heaviest existing vehicle currently in use, which is the Titan IV.

The more common medium-lift vehicles would produce less noise. At any rate, these noise levels would occur on a relatively infrequent basis and are not unusual occurrences in the local area.

At Vandenberg, the maximum estimated in-flight rocket noise that may reach any residential area under the Proposed or the No-Action Alternative are noise levels of approximately 85 decibels. These maximums are due to the heavy-lift launch vehicles and each -- this maximum is due, rather, to the heavy-lift vehicle and is less than the 88 decibels measured for the Titan IV launches at that location. Once again, the more common medium-lift launch vehicles would produce less noise.

Sonic booms occur once the launch vehicle has accelerated to the speed of sound. Booms usually occur several miles downrange from the launch complex along the flight's trajectory.

Sonic booms associated with the launches from Cape Canaveral occur over the open Atlantic Ocean generally more than 20 miles offshore. No impacts are expected from these sonic booms.

At Vandenberg, sonic booms occur south of the base along the vehicle's launch trajectory. Booms are generally 20 miles or more offshore and in some cases impact the unpopulated channel islands offshore. No adverse impacts are expected.

The No-Action Alternative will add small incremental amounts to the existing orbital debris population orbiting the earth. However, these additions will be minimized through the use of designs which minimize on-orbit explosions and resultant scattering of small pieces of hardware.

Under the Proposed Action, the EELV -- given the increased EELV Program launch rate from 472 to 566 launches over the 20-year period, there will be a nominal increase in orbital debris from domestic vehicles. However, overall there would be no significant global effects.

At Cape Canaveral under the Proposed

[illegible]

[illegible]

Preservation Office that addresses the continuing treatment of historic properties at SLC 3 at Vandenberg. Archaeological and Native American monitoring is required during ground disturbance at SLC 6 at Vandenberg under No-Action.

Activities at Cape Canaveral have been determined to have no adverse effect on any of the historic facilities at that location.

There is no change to the Environmental Justice Analysis for the Proposed Action since the FEIS was completed. In other words, the -- we found the same results in both cases. Under the No-Action Alternative, implementation of the No-Action would have no disproportionately high and adverse impacts on low-income and minority populations in the vicinity of Cape Canaveral or Vandenberg.

That concludes the presentation of the Draft SEIS results. In closing, I'd like to remind you that we are here this evening to request your input to the Environmental Impact Analysis process and specifically to hear your comments on the Draft EIS. We will be accepting written comments on the document

through December 27th at the address shown on this slide.

All comments received will be considered in the preparation of the Final EIS. Thank you very much.

COL. McSHANE: Thank you, Mr. Clark.

I'd like to remind you that if you wish to speak tonight, you should have filled out a registration card when you came in. We'll take a break here in a minute and I'll collect those from the ladies manning the registration desk and we'll come back here and then I'll call on elected officials first and then other folks who indicated that they wanted to speak.

We'll take a 10- to 15-minute break while we get the cards arranged.

(A recess was taken from 7:35 p.m. 7:45 p.m.)

COL. McSHANE: We are now going to start the main portion of the meeting which is the public comment. I would ask that you provide us your address, name and address for the record, for the court reporter. Please speak clearly and direct your comments to me.

If you are representing a specific group, please identify the group by name.

[illegible]

[illegible]

here. So I did have two other questions, though.

The presentation made the assertion that this was going to be a cheaper system. And I'm wondering how it can be a cheaper system if it, if you're talking about more launches over a longer period of time.

11-3 My second question is regarding the, the concept of the No-Action Alternative. As I understand it, you made a statement that the No-Action Alternative did not include the fact that the launch rate would be increased. And I don't understand how that fits into the No-Action Alternative.

And I'll go ahead and just give you my written statement.

COL. McSHANE: Okay, I can take that, sir, thank you.

Are you able to address that tonight or is that a matter that needs to be addressed in the final document?

LT. COL. ODLE: Well, we will address it in the final document. But for the first part, how is the program cheaper, if your launch --

MR. HERRMANN: I think the slide said something about 25 percent reduction over --

LT. COL. ODLE: Over existing launch systems, right, the Titan, Atlas, Delta, that are currently flown. And that is on a per launch basis.

MR. HERRMANN: Oh, okay, so it's more expensive than the proposed -- than the No-Action EELV, but it's cheaper than the current programs. I don't understand why you're -- I don't understand the relationship, why you're comparing it to the existing programs.

LT. COL. ODLE: The EELV Program goal was to be cheaper than the existing launch programs. That was the reason that, one of the reasons that the EELV Program came into existence.

We would have to look at the specific case by case for each mission to determine whether or not it was cheaper or not cheaper to fly a solid rocket augmented vehicle versus a medium launch vehicle. But we will certainly do that and respond to your comment, as well as comment to the second question.

MR. HERRMANN: All right.

COL. McSHANE: And are you able to address the second question tonight?

MR. CLARK: Well, I think maybe what we can try to do is clarify that a little bit more

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[illegible]

CERTIFICATE

STATE OF FLORIDA)
) SS:
COUNTY OF BREVARD)

I, DEBRA M. ARTER, Registered Diplomate Reporter, hereby certify that the foregoing proceedings were stenographically reported by me at the time and place herein designated; that my shorthand notes were thereafter transcribed into this transcript under my supervision; and the foregoing pages numbered 3 through 40, inclusive, constitute a true and correct record of the proceedings as adduced by me.

I FURTHER CERTIFY that I am not a relative, employee, attorney or counsel of the parties, nor am I financially interested in the foregoing action.

DATED this 22nd day of December, 1999.

Debra M. Arter

DEBRA M. ARTER
Registered Diplomate Reporter

NOTARY PUBLIC STATE OF FLORIDA
DEBRA M ARTER
COMMISSION # CC 547771
EXPIRES MAY 06, 2000
BONDED THRU ATLANTIC BONDING CO., INC.

STATEMENT PRESENTED AT EELV PUBLIC MEETING; 7 DEC 99 12

MY NAME IS JOHN HERRMANN. I LIVE AT 2640 VIA SAN MARINO COURT, MERRITT ISLAND FLORIDA. ALTHOUGH I WORK AT CAPE CANAVERAL AIR STATION, I AM NOT REPRESENTING MY EMPLOYER IN ANY WAY, AND THESE COMMENTS ARE STRICTLY MY OWN.

12-1 AT THE OUTSET, I STRONGLY AGREE WITH THE CONCEPT OF COMMERCIALIZATION OF SPACE. WITH COMPETITION, ACCESS TO SPACE SHOULD BECOME CHEAPER AND THE QUALITY SHOULD IMPROVE. THE PROFIT MOTIVE SHOULD PROVIDE A SUFFICIENT INCENTIVE TO ENSURE THAT ADVANCEMENTS IN TECHNOLOGY ARE APPLIED EFFECTIVELY.

12-2 MY PURPOSE FOR THIS PRESENTATION IS TO EXPRESS MY CONCERN FOR SAFETY AND FOR ENVIRONMENTAL STEWARDSHIP. TRADITIONALLY, SAFETY AND ENVIRONMENTAL COMPLIANCE ARE DRAINS ON PROFITS. THEREFORE, WE CANNOT EXPECT OR RELY UPON COMPANIES, NO MATTER HOW COMMUNITY MINDED THEY MAY APPEAR, TO SACRIFICE PROFITS, UNLESS THERE IS A SIGNIFICANT CONSEQUENCE FOR FAILURE TO COMPLY.

WE ALL RECOGNIZE THAT IN THIS AGE OF DWINDLING RESOURCES, STATE AND FEDERAL AGENCIES, CHARGED WITH INSPECTION AND ENFORCEMENT, HAVE HAD TO FACE CUT BACKS. TO OFFSET THIS, EXECUTIVE AGENCIES - FOR EXAMPLE THE AIR FORCE AND NASA - HAVE BEEN DIRECTED BY THE PRESIDENT TO BE ROLE MODELS, AND IN FACT TO BE PROACTIVE AND ASSUME LEADERSHIP ROLES IN ENSURING SAFETY AND ENVIRONMENTAL STEWARDSHIP FOR ACTIVITIES THAT FALL WITHIN THEIR PURVIEWS.

12-3 ON THE FACE OF IT, THE EELV PROGRAM WOULD APPEAR TO BE A STEP BACKWARD IN THIS REGARD. WITH THE ONSET OF LEASES AND LICENSES, IT APPEARS THAT THERE IS A CLEAR INTENT TO DELEGATE SAFETY AND

[illegible]

[illegible]

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Written Comment Sheet

received
1/3/00

Supplemental Environmental Impact Statement
for the
Evolved Expendable Launch Vehicle (EELV) Program

Thank you for attending this Public Hearing. Our purpose for hosting this hearing is to give you an opportunity to comment on issues analyzed in the Draft Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program. Please use this sheet to comment on any environmental issues that you feel should be clarified in the Final Supplemental Environmental Impact Statement.

With this EIR, lets not go overboard again. Lets remember that for the past 43 years operations at Vandenberg have been safe. There are no records or scientific facts that would point to any harm to the local environment. Environmentalism cost too much tax dollars, has done nothing to save the environment and is presently out of control. Lets keep the nonsense out of this study.

Name: Justin M Ruhge, President Concerned Taxpayers INC

Address: P.O. Box 8216, Goleta, Ca, 93118
Street Address / City/State/Zip Code

Thank you for your participation. Please hand in this form by the end of this evening's hearing or mail to the following address by December 27, 1999.

Appendix L
Notice of Intent

The following Notice of Intent was circulated and published by the Air Force in the April 12, 1999, *Federal Register* in order to provide public notice of the Air Force's intent to prepare an Environmental Impact Statement for the Evolved Expendable Launch Vehicle (EELV) program. This Notice of Intent has been retyped for clarity and legibility.

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[Federal Register: April 12, 1999 (Volume 64, Number 69)] [Notices]
[Page 17635-17636]From the Federal Register Online via GPO Access
[wais.access.gpo.gov]
[DOCID:fr12ap99-60]

DEPARTMENT OF DEFENSE

Department of the Air Force

Notice of Intent To Prepare a Supplemental Environmental Impact Statement (SEIS) for the Evolved Expendable Launch Vehicle (EELV) Program This notifies the public that the Department of the Air Force, through Space and Missile Systems Center's Evolved Expendable Launch Vehicle (EELV) System Program Office (SMC/MV), intends to supplement the EELV Final Environment Impact Statement (FEIS) and Record of Decision (ROD) dated June 8, 1998. The Air Force supplement will be prepared to further the purposes of the National Environmental Policy Act (NEPA) by inviting public involvement in the evaluation of a new, supplemental proposal to the action analyzed in the original NEPA document.

The FEIS documented the impact of implementing the EELV program. At that time, two baseline vehicle configurations were evaluated: (1) A liquid-oxygen/liquid-hydrogen core booster (with the option of small, strap-on solid rocket motors), and (2) a liquid-oxygen/kerosene core booster. The Supplemental Environmental Impact Statement (SEIS) will evaluate the proposed use of some EELV vehicle variants using large, strap-on solid rocket motors to reduce launch costs, increase mission launch options, protect launch schedules, and improve mission responsiveness. These launches would take place at Cape Canaveral Air Station (CCAS) in Florida and Vandenberg Air Force Base (VAFB) in California.

In 1994, a multi-agency Space Launch Modernization Plan was developed to evaluate national space launch systems and to improve United States launch capability. The current EELV program objectives evolved from the resulting study. The purpose of the development and deployment of the EELV is to meet the U.S. Government National Mission Model, both medium and heavy-lift, at a lower cost of launch to the nation than the present expendable launch systems (which consist primarily of Delta II, Atlas II, Titan II, and Titan IV). EELV is intended to launch national security, civil, and commercial payloads. No crew-rated or cargo-return missions are planned.

On October 16, 1998, the EELV System Program Office awarded Development Agreements and Initial Launch Services contracts to two contractors, McDonnell Douglas Corporation (a wholly-owned subsidiary of the Boeing Company) and Lockheed Martin Astronautics. Furthermore, the Air Force is preparing to enter into real property agreements with both contractors to permit the use of Air Force facilities for deployment of EELV systems. These decisions were supported by the June 8, 1998 ROD as premised upon in the EELV FEIS. Full descriptions of the previously analyzed EELV systems are available in the FEIS at the following Internet address: http://ax.laafb.af.mil/axf/EELV.htm.

In accordance with the Council on Environmental Quality Regulations implementing NEPA, specifically 40 CFR 1502.9(c), ``an agency shall

prepare supplements to either draft or final environmental impact statements when substantial changes in the proposed action are made relevant to environmental concerns.'' The proposed action to consider permitting the use of EELV vehicles using larger strap-on solid rocket motors may be considered a substantial change to the action[[Page 17636]] previously analyzed in the FEIS and would present different potential environmental impacts due to the use of different propellants. The size and number of solid rocket motors to be used on each launch vehicle will be proposed by the launch vehicle contractors, Lockheed Martin and the Boeing Company. The solid propellant to be used in the strap-on motors will most likely consist of ammonium perchlorate, aluminum, and organic binder. Details regarding propellant composition, propellant masses, and emissions impacts will be included in the SEIS. Because of the projected differences in the environmental impacts between the systems previously examined and the new alternative, the Department of the Air Force will prepare a supplement to the EELV FEIS.

The SEIS will analyze the potential environmental impacts resulting from the use of solid rocket motors on EELV vehicles. Both government and commercial launches will be analyzed to assess cumulative effects. The total EELV launch rate including launches using solid rocket motors are not expected to exceed those addressed in the FEIS. The first launch of a solid rocket motor variant is anticipated in 2001 at CCAS and 2002 at VAFB. EELV launches using solid rocket motors are not expected to exceed 7 to 12 per year from VAFB and 14 to 21 launches per year from CCAS.

The no-action alternative to the proposed action is to limit EELV launches from Air Force facilities to those launch vehicle variants previously analyzed in the FEIS. That is, the Government could choose not to permit the use of strap-on solid rocket motors. This would result in the use of only the systems considered in the June 1998 ROD.

Environmental issues to be analyzed in the SEIS include, but are not limited to: air quality, hazardous materials processing, hazardous waste, stratospheric impacts, health and safety, launch debris, launch noise, sonic boom impacts, construction modifications due to program changes from FEIS, and effects of new launch variants on biological species, ground waters, and all other natural and cultural resources.

The Air Force is soliciting public input and comments concerning the environmental aspects to be addressed in the SEIS. To ensure that the Air Force has sufficient time to fully consider public response, written comments need to be received no later than April 26, 1999. Comments should be mailed to: SMC/AXFV, Attn: Ted Krawczyk, Environmental Engineer, 2420 Vela Way, Suite 1467, El Segundo, CA 90245-4659. Comments may also be sent via fax (310) 363-1503, and e-mail: Theodore.Krawcyzk@losangeles.af.mil. The SEIS is expected to be available for public review in Summer 1999.

A notice of availability will be published in the Federal Register announcing issuance of the draft SEIS.

Carolyn A. Lunsford,
Air Force Federal Register Liaison Officer.
[FR Doc. 99-8977 Filed 4-9-99; 8:45 am]
BILLING CODE 5001-05-U

Appendix M
Final Supplemental Environmental Impact Statement
List of Recipients of Notice of Availability

This list of recipients of the Notice of Availability (NOA) of the FSEIS includes federal, state, and local agencies and individuals that have expressed an interest in the document. This list also includes the governors of Florida and California, as well as United States senators and representatives and state legislators.

ELECTED OFFICIALS

Federal Officials — State of Florida

U.S. Senate

The Honorable Robert Graham
The Honorable Connie Mack

U.S. House of Representatives

The Honorable David Weldon

Federal Officials — State of California

U.S. Senate

The Honorable Barbara Boxer
The Honorable Dianne Feinstein

U.S. House of Representatives

The Honorable Lois Capps

State of Florida Officials

Governor

The Honorable Jeb Bush

Senate

The Honorable Charlie Bronson
The Honorable Patsy Ann Kurth

State of Florida Officials (Continued)

Assembly

The Honorable Randy Ball
The Honorable Howard Futch
The Honorable Harry C. Goode, Jr.
The Honorable Bill Posey

State of California Officials

Governor

The Honorable Gray Davis

Senate

The Honorable Jack O'Connell

Assembly

The Honorable Abel Maldonado
The Honorable Hannah—Beth Jackson

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The Honorable Ray Rodriguez
Commissioner, City of Cocoa Beach

The Honorable Larry Bartley
Mayor of Titusville

The Honorable John Blubaugh
Council Member, City of Cocoa

The Honorable John Buckley
Mayor of Melbourne

The Honorable Sue Carlson
Brevard County Commissioner, District 4

The Honorable Nancy Higgs
Brevard County Commissioner, District 3

The Honorable Barbara Stevens
Vice Mayor of Cocoa

The Honorable Janice Scott
Commissioner, City of Cocoa Beach

The Honorable James Kelley
Mayor of Melbourne Beach

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The Honorable Randy O'Brien
Brevard County Commissioner, District 2

The Honorable Buzz Petsos
Mayor of Cape Canaveral

The Honorable Rocky Randels
Mayor Pro—Tem, City of Cape Canaveral

Charles Rowland, Executive Director
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The Honorable Bill Lane
Mayor of West Melbourne

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Mayor of Santa Maria

The Honorable Dick DeWees
Mayor of Lompoc

The Honorable Mary Leach
Lompoc Councilwoman

The Honorable Renaldo Pili
Mayor of Guadalupe

The Honorable Mike Siminski
Lompoc Councilman

The Honorable Joni Gray
Santa Barbara County 5th District Supervisor

The Honorable George Stillman
Lompoc Councilman

The Honorable Kathy Long
Santa Barbara County 3rd District Supervisor

GOVERNMENT AGENCIES

Federal Agencies

Advisory Council on Historic Preservation

Department of the Interior
Bureau of Indian Affairs

Department of the Interior
Office of Environmental Policy and Compliance

Environmental Protection Agency

Federal Aviation Administration, Office of Commercial Space Transportation

Federal Emergency Management Agency

National Aeronautics and Space Administration

Department of Defense

AFCEE/CCR-A

AFCEE/CCR-S

MAJ Steven H. Boyd
AFOTEC/OL-BC

Regional Offices of Federal Agencies — State of Florida

Department of Commerce
National Marine Fisheries Service
Southeast Regional Office

Department of the Interior
Fish and Wildlife Service, Regional Office
Jacksonville, Florida

Department of the Interior
Fish and Wildlife Service
Merritt Island National Wildlife Refuge
Titusville, Florida

Department of the Interior
National Parks
Cape Canaveral National Seashore
Titusville, Florida

Environmental Protection Agency, Region IV
Atlanta, Georgia

Kennedy Space Center

Regional Offices of Federal Agencies — State of California

Department of Commerce
National Marine Fisheries Service
Southwest Regional Office

Department of the Interior
San Francisco, California

Department of the Interior
Fish and Wildlife Service
Ventura, California

Environmental Protection Agency, Region IX
San Francisco, California

State of Florida Agencies

Department of Community Affairs

Department of Natural Resources

Department of State, Division of Historic Resources

East Central Florida Regional Planning Council

Florida Department of Environmental Protection

Florida State Clearinghouse

Game and Fresh Water Commission

State of California Agencies

Cal EPA/DTSC

Cal EPA/DTSC Legislative Analysis

California Air Resources Board

California Department of Fish and Game
Paso Robles, California

California Department of Fish and Game
Sacramento, CA

California Regional Water Quality Control Board

California Resources Agency

Clean Water Action

Environmental Health Services

State of California Agencies (Continued)

Federal Programs

Office of Historic Preservation

State Clearinghouse

State Coastal Conservancy

Local Agencies — CCAFS

Brevard County Emergency Management

Brevard County Natural Resources

St. John's River Water Management District

Local Agencies — Vandenberg AFB

Economic Development Association

Environmental Health Services

Hazardous Materials Environmental Safety (CAER)

Lompoc Public Works

Public Safety Department
City of Solvang

San Luis Obispo County Board of Supervisors

Santa Barbara County Air Pollution District

Santa Barbara County Environmental Health Department

Santa Barbara County Fire Department

Santa Barbara Water Agency

Santa Ynez River and Water

Southern California Association of Governments

Water Resources

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Cape Canaveral Library

Central Brevard Library

Cocoa Beach Library

Melbourne Library

Merritt Island Library

North Brevard Library

Palm Bay Library

Libraries — California

Lompoc Public Library

San Luis Obispo City/County Library

Santa Maria Public Library

California Polytechnic State University
Robert F. Kennedy Library

University of California, Santa Barbara
Davidson Library, Reference Services

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Appendix N
Federal Permits, Licenses, and Consultation

The following Table N-1, Representative Federal Permits, Licenses, and Consultation, lists the title of the permit, license, or entitlement; typical activities or persons who must obtain the permit, license, or entitlement; the authority issuing the permit, license, or entitlement; and the regulatory agency responsible for monitoring the permit, license, or entitlement.

TABLE N-1
Representative Federal Permits, Licenses, and Consultation
Page 1 of 2

Permit, License, or Consultation	Typical Activity, Facility, or Category of Persons Required to Obtain the Permit, License, or Consultation	Authority	Regulatory Agency
Federal			
Clean Air Act (CAA) Title V Permit	Any major source (source that emits more than 100 tons/year of criteria pollutant in a nonattainment area for that pollutant or is otherwise defined in Title I of CAA as a major source); affected sources as defined in Title IV of CAA; sources subject to Section 111 regarding New Source Performance Standards; sources of air toxics regulated under Section 112 of CAA; sources required to have new source or modification permits under Parts C or D of Title I of CAA; and any other source such as Hazardous Waste pollutants designated by U.S. Environmental Protection Agency (U.S. EPA) regulations.	Title V of CAA, as amended by the 1990 CAA Amendments	U.S. EPA; Florida Department of Environmental Protection (FDEP)
National Pollutant Discharge Elimination System (NPDES) Wastewater Permit	Discharge of pollutant from any point source into waters of the United States.	Section 402 of Clean Water Act, 33 U.S.C. Section 1342	U.S. EPA, FDEP, Central Coast Regional Water Quality Control Board (CCRWQCB)
NPDES Stormwater Discharge Permit	Discharge of storm water during construction projects disturbing 5 acres or more.	Federal Water Pollution Control Act of 1972, also known as the Clean Water Act, as amended [Section 402(p)]	U.S. EPA, St. John's River Water Management District (SJRWMD), CCRWQCB
Section 404 (Dredge and Fill) Permit	Any project activities resulting in the discharge of dredged or fill material into bodies of water, including wetlands, within the United States.	Section 404 of Clean Water Act, 33 U.S.C. Section 1344; Chapter 62-312, Florida Administrative Code (FAC)	U.S. Army Corps of Engineers, in consultation with U.S. EPA; SJRWMD; CCRWQCB
Hazardous Waste Treatment, Storage, or Disposal (TSD) facility permit	Owners or operators of a new or existing hazardous waste TSD facility.	Resource Conservation and Recovery Act (RCRA) as amended, 42 U.S.C. Section 6901; Title 40 Code of Federal Regulations (CFR); Chapter 403, 704, 403, 721, 403, 8055, Florida Statutes (FS); Chapter 62-730, 180, FAC	U.S. EPA; FDEP; California EPA, Department of Toxic Substances Control

TABLE N-1
Representative Federal Permits, Licenses, and Consultation
Page 2 of 2

Permit, License, or Consultation	Typical Activity, Facility, or Category of Persons Required to Obtain the Permit, License, or Consultation	Authority	Regulatory Agency
Archeological Resources Protection Permit	Excavation and/or removal of archaeological resources from public lands or Indian lands and carrying out of activities associated with such excavation and/or removal.	Archaeological Resource Protection Act of 1979, 16 U.S.C. Section 470cc	U.S. Department of the Interior, National Park Service
Endangered Species Act Section 7 Consultation	Taking endangered or threatened wildlife species; engaging in certain commercial trade of endangered or threatened plants or removing such plants on property subject to federal jurisdiction.	Section 7 of Endangered Species Act, 16 U.S.C. Section 1539; Title 50 CFR 17 Subparts C, D, F, and G	U.S. Department of the Interior, Fish and Wildlife Service
Marine Mammal Protection Act	Any project activities resulting in the incidental, but not intentional, taking of marine mammals by United States citizens who engage in specified activities (other than commercial fishing).	16 U.S.C. 1361 et. seq.	National Marine Fisheries Service
Consistency Determination (Supplement) with the Florida Coastal Management Act (FCMA)	Applies to activities occurring in or affecting the coastal zone. For the purposes of the FCMA, the entire state of Florida is defined as being within the coastal zone.	Coastal Zone Management Act, as amended (16 U.S.C. Section 1451 – 1464), and Section 930.30 *et seq.* Of the National Oceanic and Atmospheric Administration Federal Consistency Regulations (15 CFR 930)	DEP, Florida Coastal Management Program
Consistency Determination (Supplement) with the California Coastal Management Program	Applies to federal activities occurring in or affecting the coastal zone.	Coastal Zone Management Act of 1972, as amended, Section 307 [16, U.S.C. 1456(c)] and Section 930.30 *et seq.* of the National Oceanic and Atmospheric Administration Federal Consistency Regulations (15 CFR 930)	California Coastal Commission

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Appendix O
Noise Below Water from Sonic Booms

1.0 Background

Noise transmission below water is described differently than noise transmission above water. The noise measurement unit used to describe the level of noise transmitted through air is the decibel (dB), commonly based on a reference overpressure of 0.0002 dyne/cm^2, written specifically as "dB (re 0.0002 Bar)." The same logarithmic unit (dB) is commonly used in underwater acoustics, but with a different reference pressure. The typical reference pressure used in underwater acoustics is one micro-Pascal (1 μPa), written as "dB (re 1 μPa)," where μPa means 10^{-6} Pascal. To convert "dB re .0002 Bar" to "dB re 1 μPa," add 26 dB to the former (i.e., dB [re 1 μPa] = dB [re 0.0002 Bar] + 26) (Pierce, A.D., 1994; Richardson, et al., 1995).

In analogy with classical optics, acoustic-pressure signals can penetrate rather deeply into water, as long as the incident ray angle θi measured from the vertical plane does not exceed the critical value θc = sin-1(aA/aW), where (aA/aW) is the air-to-water sound-speed ratio. The reciprocal of this ratio is 4.53 (under standard conditions). Therefore, for the incident ray angle θi<θc = sin-1(1/4.53)=12.75°, penetration of acoustic disturbances deeply into the water is possible. This figure corresponds to the condition that the wave fields move horizontally at supersonic speed both above and below the air-water interface, and that the horizontal Mach number of the vehicle (in steady motion) must be greater than aW/aA or 4.53. For θi>θc=12.75° (corresponding to a horizontal Mach number less than 4.53, commonly found with supersonic aircraft and space launches during the ascending phase), the ray theory as an approximation underlying the sonic boom analysis would predict a "total reflection," allowing no acoustic energy to be transmitted from air into water. The prediction method based on the ray approximation does not apply underwater for θi>12.75°, so must be replaced by a fuller analysis.

The overpressure level, signature length, and penetration depth underwater depend significantly on the launch vehicle thrust and weight, which determine the sonic boom disturbances from the rocket plume. Therefore, the underwater overpressure levels from the Atlas V system with Solid Rocket Motors (SRMs) and Delta IV system with larger SRMs would be greater than those reported in a study of Minuteman-type launches for the Air Force Atmospheric Interceptor Technology (AIT) program at Kodiak, Alaska (SMC, 1997), and less than those produced by the Titan or Saturn rockets (Cheng and Lee, 1998).

2.0 Underwater Noise Models

Two types of analysis methods for underwater sonic boom noise are available. One is based on the Sawyer method (1968 model), which accounts for the penetration of sonic boom disturbances under a flat ocean. The other model is based on the surface wave influence on

the sonic boom penetration into the deep ocean (Cheng and Lee, 1998). The flat-ocean model is useful in providing the underwater overpressure field not far from the sea surface where potential sonic boom effects on marine mammals pertaining to "Harassment A," such as the hearing-threshold shift (Bowles and Stewart 1980), may be found. Cheng and Lee's (1998) model accounting for the surface wave influence furnishes a method for assessing the audibility of the sonic boom noise in deep water, because the interaction effect of sonic boom and a surface wave train has been shown to overwhelm the flat-ocean wavefield at large depth, in frequency range of 5 to 50 Hz, where the overpressure level is low, but still is noticeable above the ambient noise level of 60 to 80 dB (re 1 μPa) (Urick, 1983).

Four booms from each launch were selected for the underwater analyses. Using names of the AF trajectory file, the four launches are designated by Eastern Range low earth orbit (ERLEO), Eastern Range geosynchronous transfer orbit (ERGTO), Western Range low earth orbit (WRLEO), and Western Range geosynchronous transfer orbit (WRORB). The four booms for each launch are distinguished as follows: FOC (focus boom on centerline), focus boom at the carpet edge (EDG), centerline carpet boom (CPT) and carpet boom at a position of 1/2 CPT overpressure level (CP2).

Common and similar features of the sea-level waveforms for the booms include: FOC, EDG, CPT, and CP2. Such common features facilitate study and inferences regarding wavefield properties underwater and reduce analysis effort for both flat- and wavy-surface models. Study and assessment based on the wavefield similarities afforded by theories of Sawyer (1968) and Cheng and Lee (1998) must consider not only differences in the overpressure level and overall signature length scale of the input sea-level waveforms, but also the Mach number of the horizontal velocity component of the wavefield. The importance of the horizontal Mach number has been made apparent by examples in Sparrow's (1995) study. Simulation studies of the sonic-boom and surface-wave interaction show that one must also consider the wave length of the surface-wave train. The latter depends on the sea state (Cheng and Lee 1998). In the discussion described below, Cheng and Lee's theory is used to assess the surface waviness influence, based on parameters determined from the sea-level overpressure data.

The distinct features shared by the sea-level waveforms of the FOC and EDG are not only the sharp peaks ("rabbit ears") next to the front and tail shocks, but also the notably low overpressure level elsewhere in the waveform. The latter resembles an asymmetrical N-wave with a tail shock that is 10 to 20 percent weaker than that in the front. While the sea-level CPT of the same launch has a similar asymmetrical N-waveform, it is considerably stronger, which explains why the noise from CPT can dominate an underwater noise field even at a depth that would be small compared to the signature length, because the peaky features of FOC and EDG attenuate rapidly with distance, as have been found for all the launches in the current study. The depth where FOC and EDG effects falls off underwater and the CPT effects takes over seldom exceeds 50 feet for the Delta IV system and 60 feet for the Atlas V system. Above these levels, however, the overpressure levels under a FOC/EDG rise rapidly to match the very high focus boom level (see below). In this 50- to 60-foot upper layer of the ocean, the potential "Harassment A" on marine mammals can be an issue. Overpressure contours in the vertical plane and other wavefield details have been computed for all given sea-level waveforms, and are discussed below.

Under a wavy ocean in a fully developed sea state (Bascom, 1964; Stewart, 1969), the example in Cheng and Lee (1998) has indicated that an incident N-wave from a supersonic aircraft that generates 2 psf peak overpressure at sea level may cause a 100 to 120 dB (re 1 μPa) maximum overpressure at a depth of one-half kilometer in the 20 to 25 hertz (Hz) frequency range. These overpressure and frequency ranges are comparable to the dominant part of the vocalization records of blue whale and fin whale calls (Richardson, et al., 1995). The overpressure level mentioned is noticeably higher than the 80 dB (re 1 μPa) of the ambient noise of the deep sea in the 20 to 25 Hz range (Urick, 1983), and should be audible. The surface horizontal Mach numbers of all of the booms considered are much closer to unity (1.08 to 1.12) than the example in Cheng and Lee (1.8). One may expect, according to the theory, that the noise penetration power augmented by surface-wave influence can be several times stronger than was reported by Cheng and Lee (1998). On the other hand, the ratio of surface-wave length to the signature length is smaller for the present problem than for the aircraft example from Cheng and Lee. A close examination of deep-water analysis in Cheng and Lee's solution for the Mach number and surface-wave number yields neither exceedingly high nor low overpressure magnitude. Therefore, the audibility issue remains the same as for the aircraft example indicated above. In summary, the assumption of a flat wave state in the model used in this analysis is expected to yield a rough approximation of actual effects. A definitive study for the waviness and related sea-state issues must await a more concrete analysis.

3.0 Underwater Noise Analysis Results

3.1 Atlas V System with SRMs

The sea-level waveforms from the Atlas V system launches are quite close to one another in each of the four types: the FOC, EDG, CPT, and CP2, with exceptions noted below.

Cape Canaveral Air Force Station

Sonic booms occurring at Cape Canaveral Air Force Station (CCAFS) during several launches from the east range have been considered. Figures O-1 to O-4[1] show the sea-level overpressure waveforms of the Atlas V system LEO launch, marked with the local horizontal Mach numbers, for the four FOC, EDG, CPT and CP2 type booms, respectively. The maximum overpressure at the spiky peak is 7.3 pounds per square foot (psf) in FOC and 3 psf in EDG, while the maximum overpressure is 2.8 psf in CPT and 1.9 psf in EDG. The FOC and EDG waveforms appear to be the results of adding the two spikes (rabbit ears) to a slightly modified N-wave. The signature length of these waveform varies slightly within 600 to 650 feet, except for the longer length, 1,030 feet, in the CP2. The sea-level waveforms for the Atlas V system LEO launch are very close to those shown for Atlas V system GTO.

Among the underwater wavefield data generated by the flat-ocean model for the four types of sea-level waveforms, the plots of the overpressure as a function of depth, z (in feet), are presented and compared in Figure O-5 for the Atlas V system GTO launch from the east range. A significant feature in this comparison, which is shared by all Atlas V system and

[1] All figures follow the text of this appendix.

Delta IV launches under study, is that high overpressures comparable to that on the sea surface are found mainly within the first 60 feet underwater. The plot shows that the magnitudes attenuate rapidly with increasing depth, reducing to 0.3 psf or less at the 400-foot depth. Similar results for an Atlas V system LEO launch with azimuth angle 43° are given in Figure O-6.

Vandenberg AFB

The launches from the west range yield sea-level sonic boom waveforms very close to those from the east range in their respective waveform types, as shown in Figures O-1 to O-4 for Atlas V system LEO. The plots of maximum overpressure versus depth z for the three west-range launches, Atlas V system GTO (94°), Atlas V system LEO (43°) and Atlas V system (158°), are shown in Figures O-5, O-6, and O-7. These figures reveal little variation from launch to launch, and are similar to those of the east-range launches.

3.2 Delta IV System with Larger SRMs

The sea-level waveforms from the Delta IV system launches are almost identical to one another in each of the four types (FOC, EDG, CPT, and CP2), except for those from the ERLEO launch, which yields lower maximum overpressure, but is similar otherwise.

Cape Canaveral Air Force Station

Launches considered from CCAFS are ERGTO and ERLEO launched from the east range. Figures O-8 to O-11 show the sea-level overpressure waveforms, marked also with the local horizontal Mach numbers for FOC, EDG, CPT, and CP2 of the ERGTO, respectively. The maximum overpressure at the spiky peaks is seen to be 7.4 psf in the FOC and about 6 psf in the EDG, while the maximum overpressure is close to 4 psf in the CPT and to a lower 2 psf in the CP2. Notice that the sea-level overpressure immediately after (downstream of) the peak is not far from 2 psf in both FOC and EDG booms, which is certainly lower than the 4 psf maximum of the CPT. The sea-level signature lengths vary only slightly between 485 and 500 feet among various waveform types, with the exception of WRORB which has a shorter length (460 feet) along with a lower maximum overpressure (6 psf). These differences and similarities among the four waveform types that affect/determine the underwater impact are common to most launch results.

From the underwater wavefield computed according to the flat-ocean model, the maximum overpressure underwater is plotted as a function of depth, z (in feet), for each of the sea-level waveforms, as shown in Figure O-12. As noted earlier, the high overpressure level associated with spike-like features in the FOC and EDG attenuates rapidly underwater, but remains significant at a depth of 50 feet. At this depth and below, where the maximum overpressure level is 2 psf, the CPT is seen to dominate. The plot shows that the overpressure level from the CPT can be as high as 1/3 psf at 400 feet below sea level.

Figures O-13 and O-14 show examples of the overpressure contour in the vertical plane for the FOC and CPT sea-level waveforms of the ERGTO launch. The asymmetry in the contour plots in both figures reflects the asymmetry originated from the modified N-waves FOC and CPT sea-level waveforms noted earlier. Comparing the contour plots of the figures reveals clearly the pervasive nature of the CPT boom in the deeper part of the water; it indicates that a 0.10 psf overpressure from the CPT boom can be found at 1,000 feet below

sea level, even in the absence of surface-wave influence. This result is typical of all CPTs of the launch series considered (except for the ERLEO launch, which can reach only 800 feet below sea level).

Figure O-15 compares underwater maximum overpressure for FOC, EDG, CPT, and CP2 sonic boom types generated by the ERLEO launch at various depths down to 400 feet. Most features and remarks noted earlier for Figure O-12 for the ERGTO launch apply equally here, except for the noticeably reduced overpressure levels, which are more than 40 percent lower than in the other cases.

Vandenberg AFB

The maximum overpressure at various depths for FOC, EDG, CPT, and CP2 are shown in Figure O-16 for WRLEO launch. Here, the features and remarks noted earlier on Figure O-12 for the ERGTO launch also apply, except that the maximum overpressure near sea level is slightly higher for the EDG and slightly lower for the CPT. The corresponding plots for the WRORB launch are presented in Figure O-17, which is comparable to results from the ERGTO launch shown in Figure O-12.

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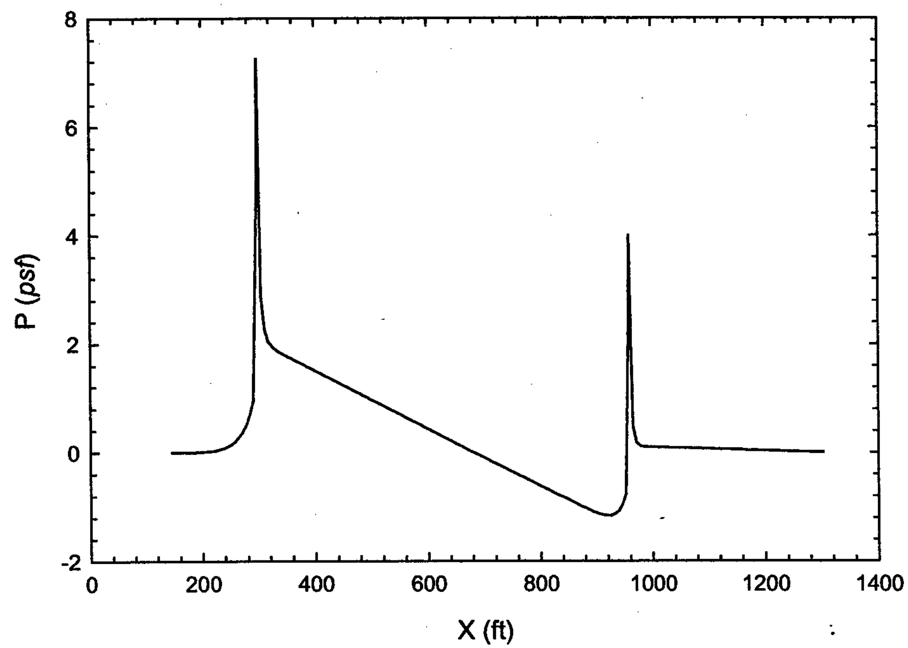

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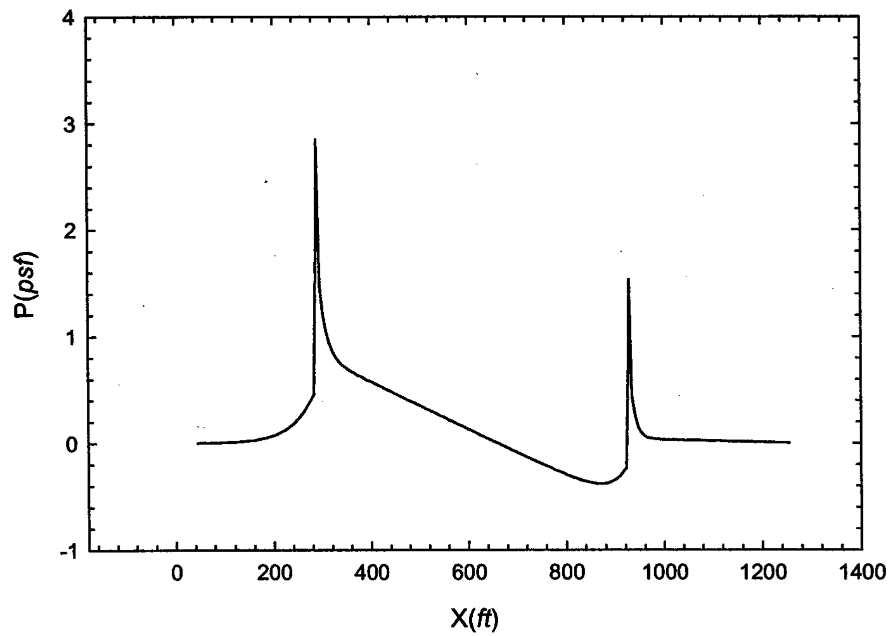

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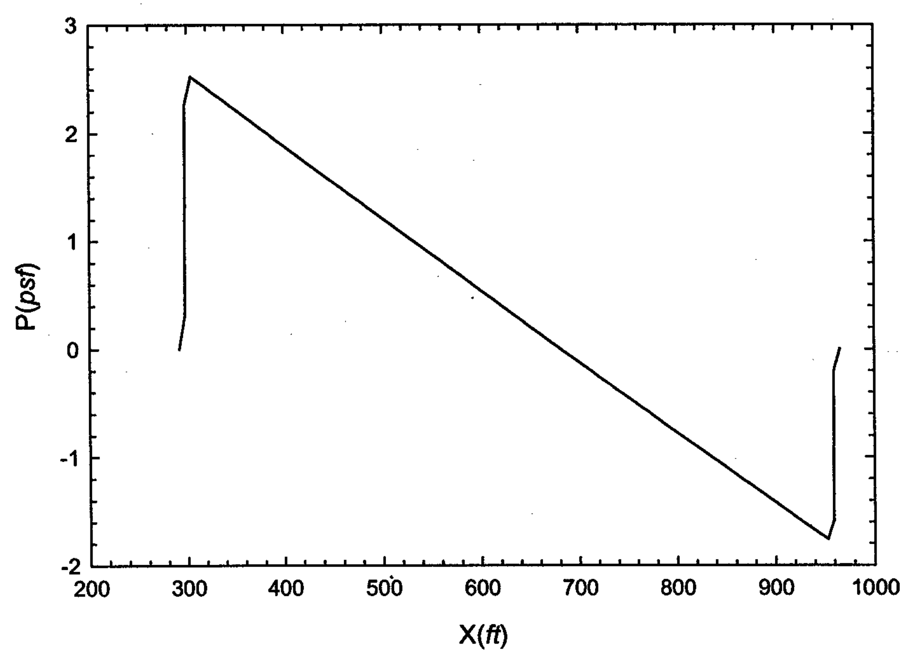

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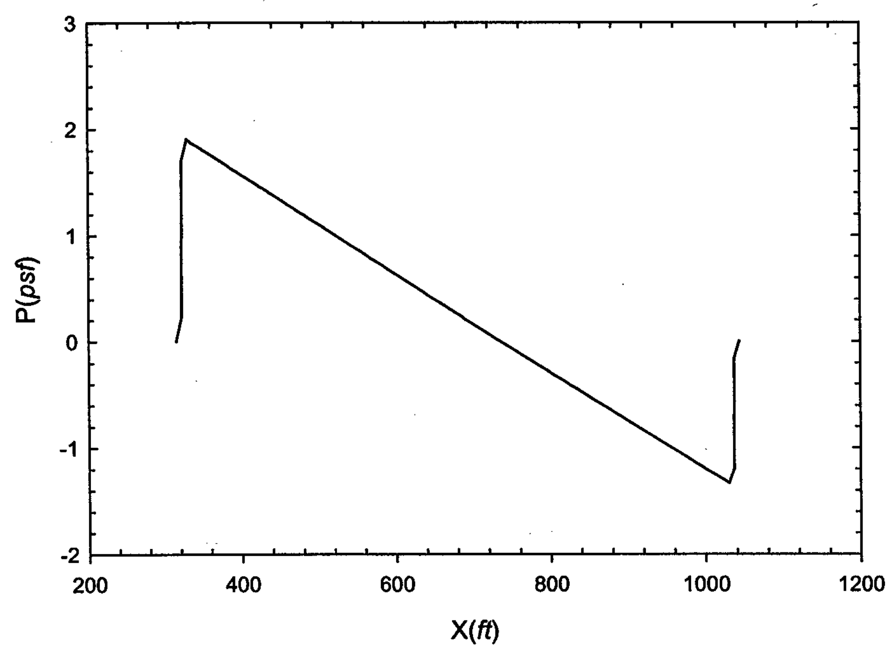

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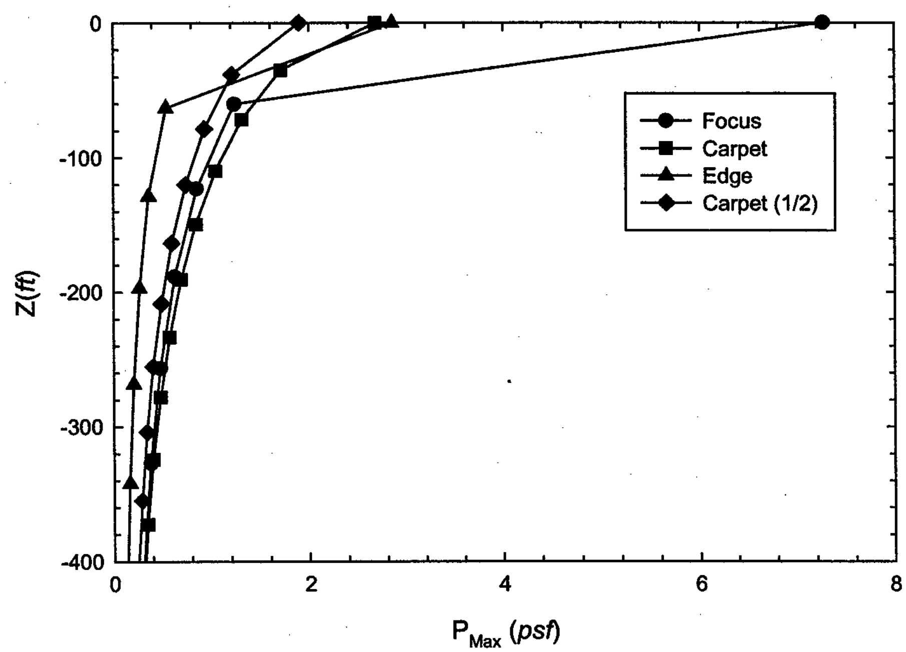
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2
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8
P_{Max} (psf)
Focus
Carpet
Edge
Carpet (1/2)

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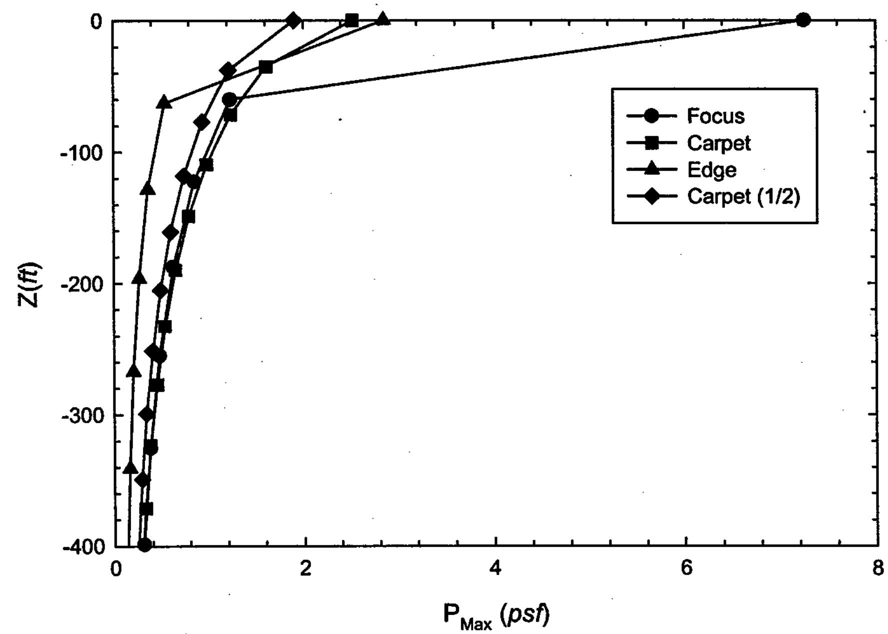
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Z(ft)
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P_Max (psf)

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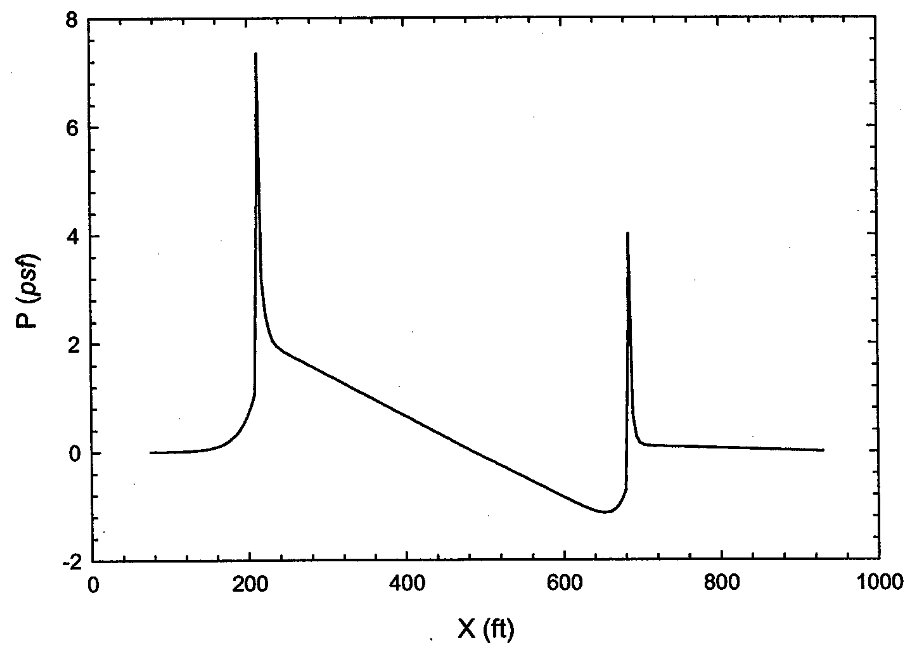

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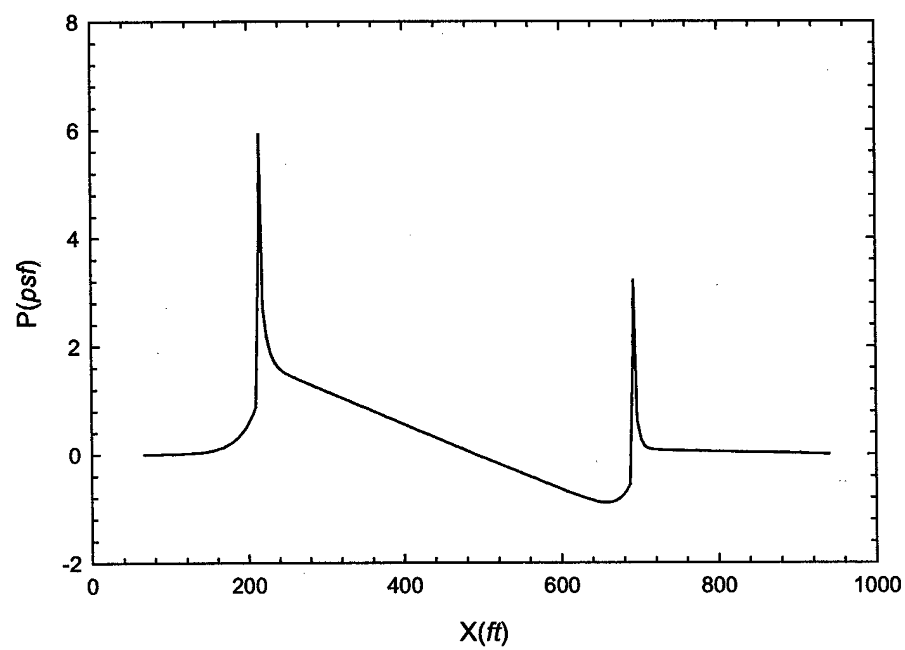

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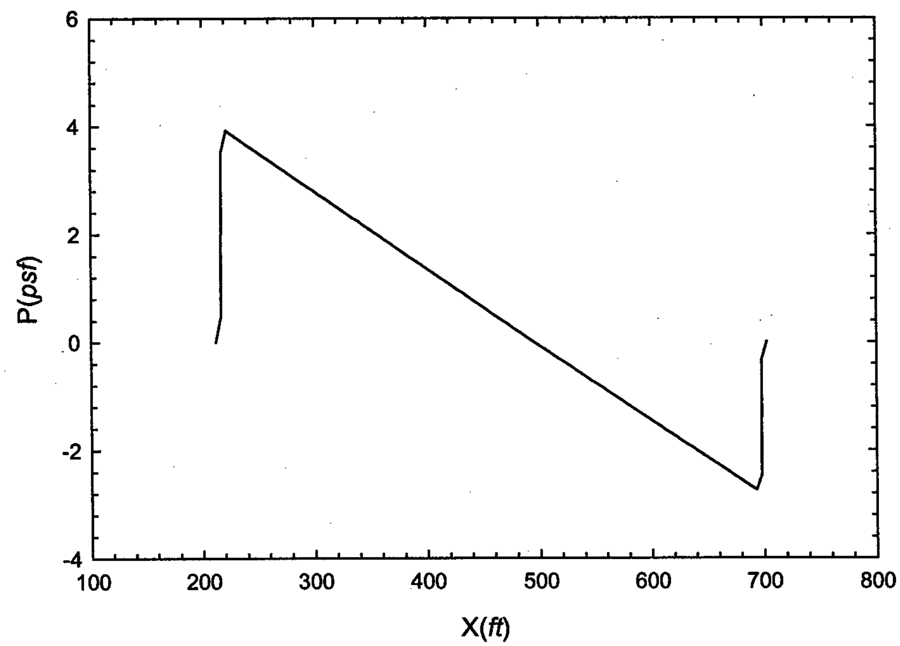

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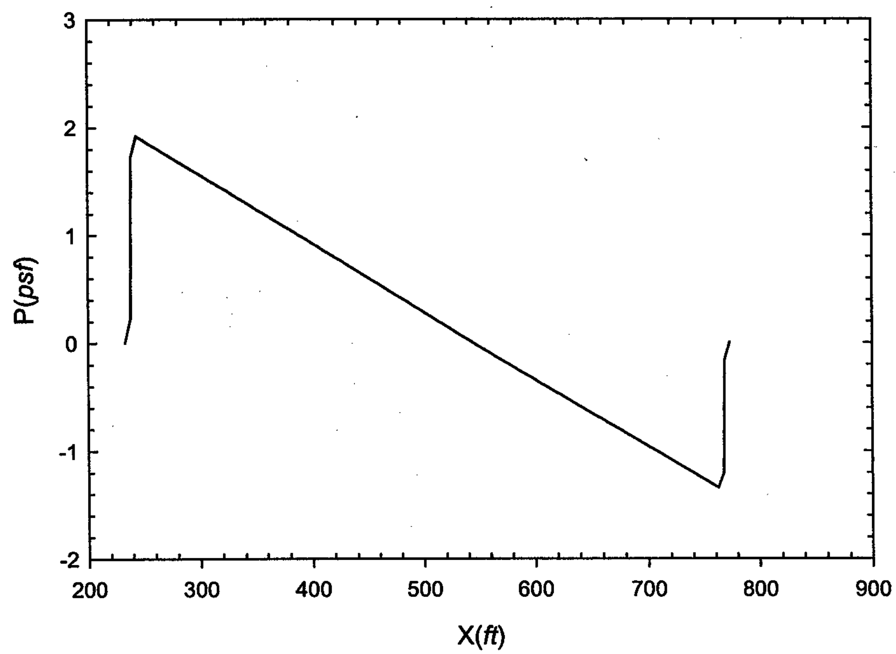

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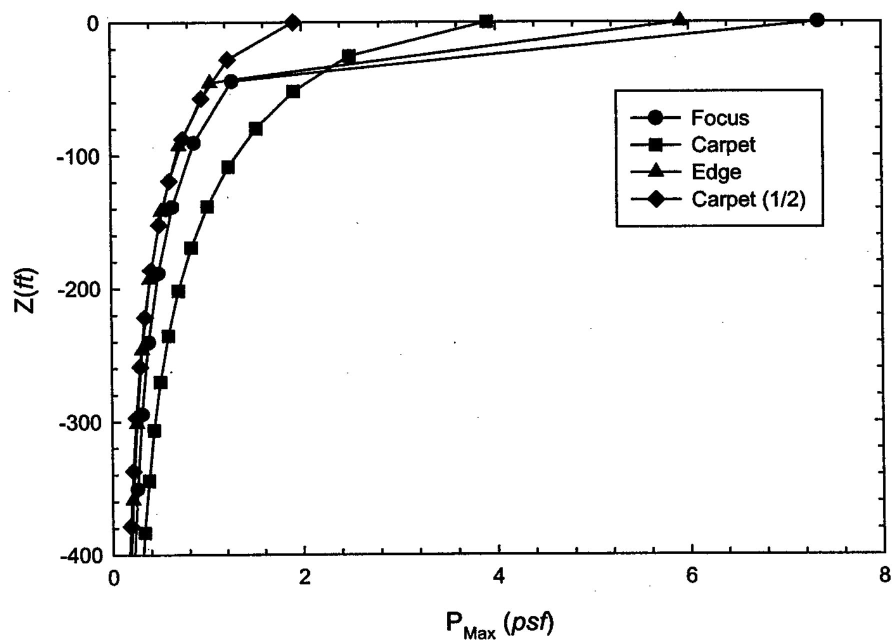
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2
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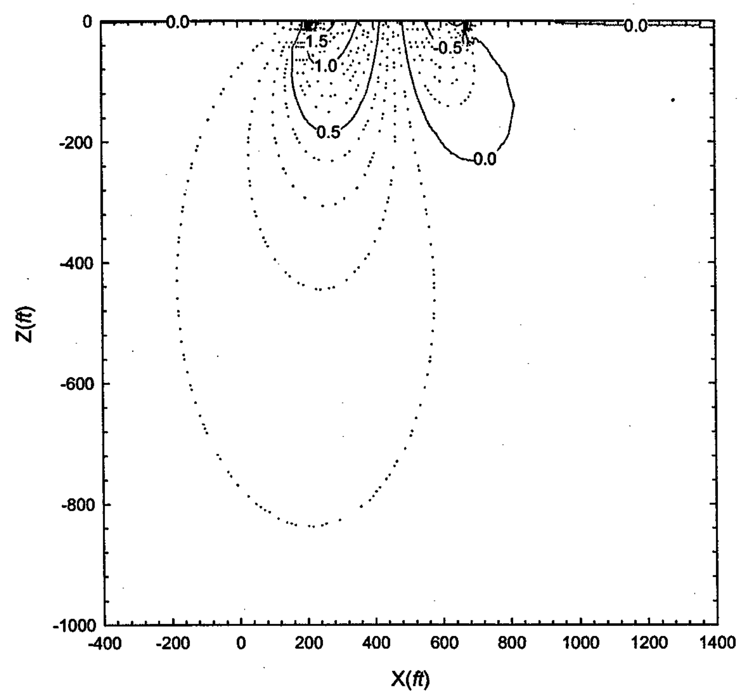
8
P_{Max} (psf)

Figure O-12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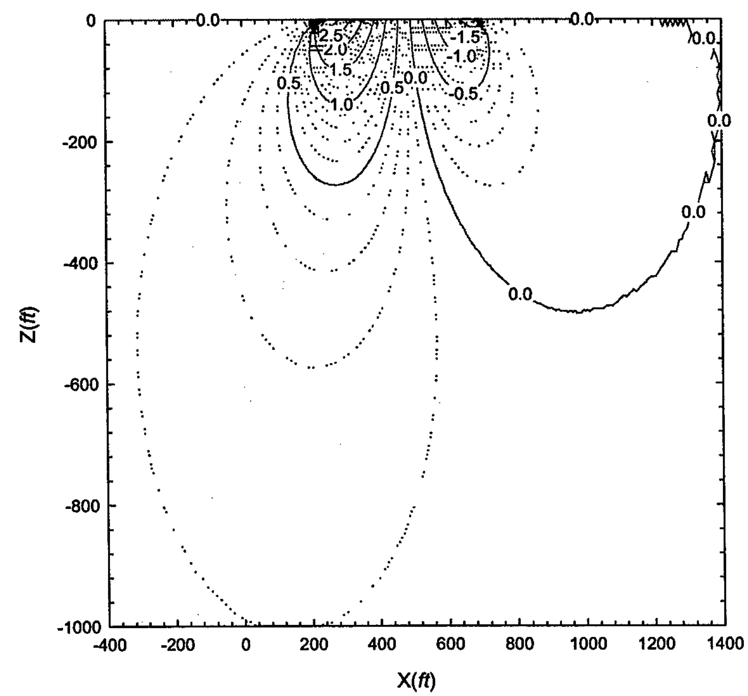
-200
0
200
400
600
800
1000
1200
1400
X(ft)

Figure O-13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X(ft)
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-400
-600
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-1000
-400
-200
0
200
400
600
800
1000
1200
1400
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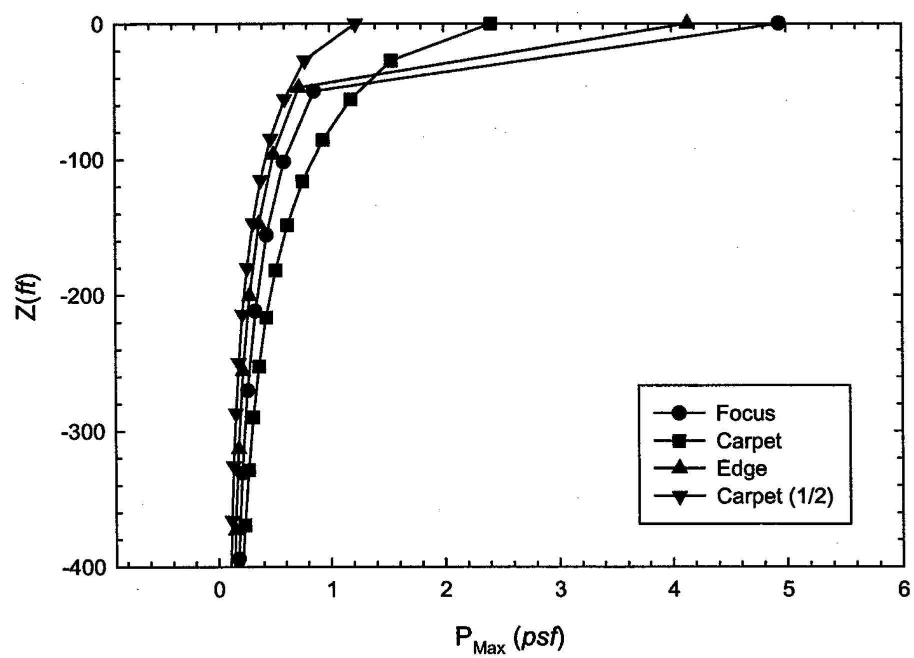
2.0
1.5
1.0
0.5
-1.5
-1.0
-0.5

Figure O-14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-100
-200
-300
-400
Z(ft)
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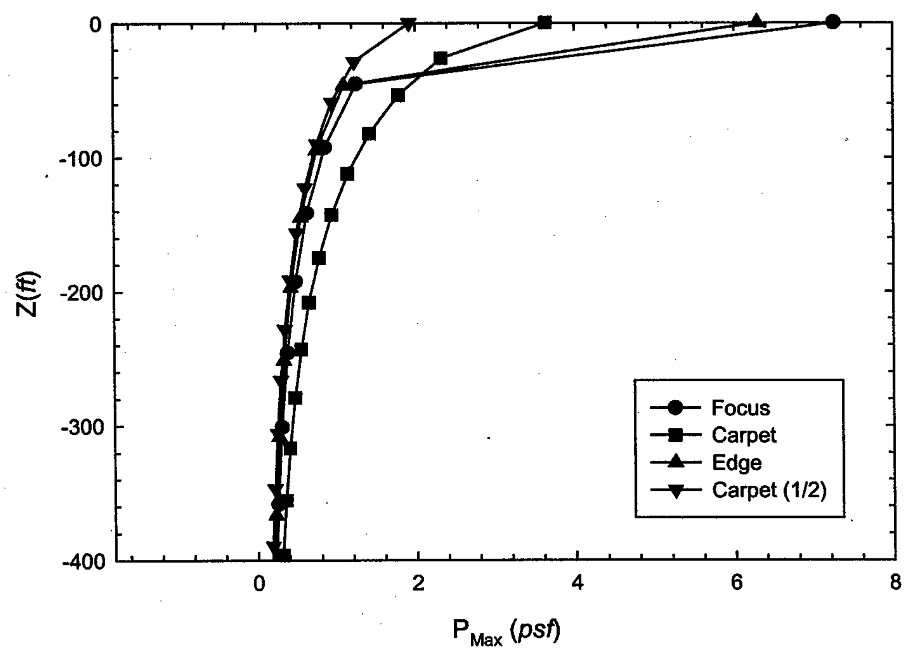
1
2
3
4
5
6
P_{Max} (psf)
Focus
Carpet
Edge
Carpet (1/2)

Figure O-15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-100
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-400
Z(ft)
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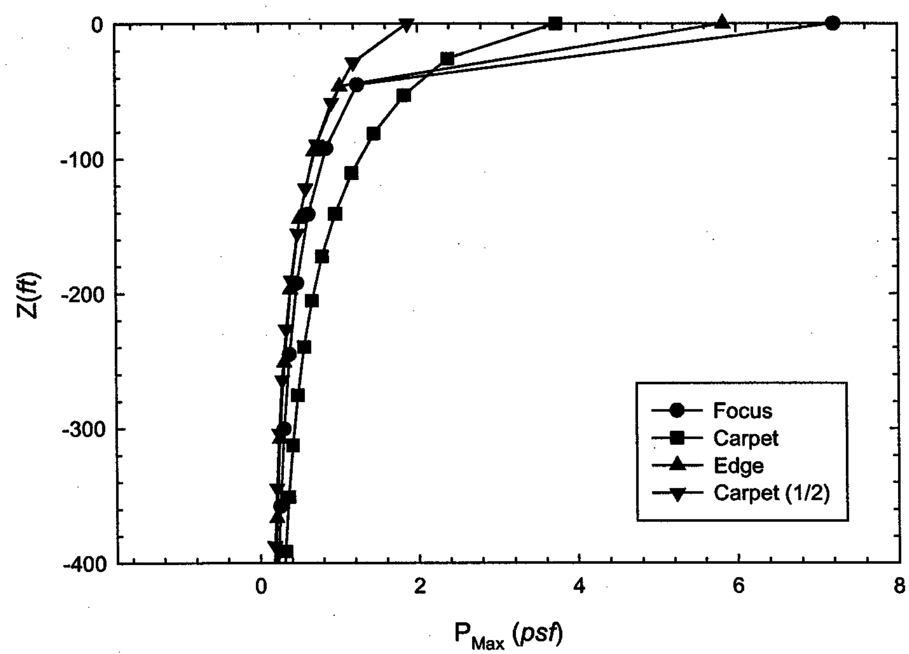
2
4
6
8
P_Max (psf)
Focus
Carpet
Edge
Carpet (1/2)

Figure O-16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-400
Z(ft)
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2
4
6
8
P_{Max} (psf)
Focus
Carpet
Edge
Carpet (1/2)

Figure O-17

Appendix P
Consultation Status

United States Fish and Wildlife Service Consultation

The attached letter, dated May 18, 1998 represents the Biological Opinion for SLC 37 at Cape Canaveral Air Force Station (CCAFS), as rendered by the Fish and Wildlife Service of the Department of the Interior.

National Marine Fisheries Service Consultation

The attached letter, dated February 29, 2000, represents the initiation of formal consultation with the National Marine Fisheries Service for both CCAFS and Vandenberg Air Force Base.

Office of Historic Preservation

The attached letters from the California and Florida State Historic Preservation Offices represent the results of consultation with SHPOs.

Appendix Q
Launch Debris and Staging Impact Locations

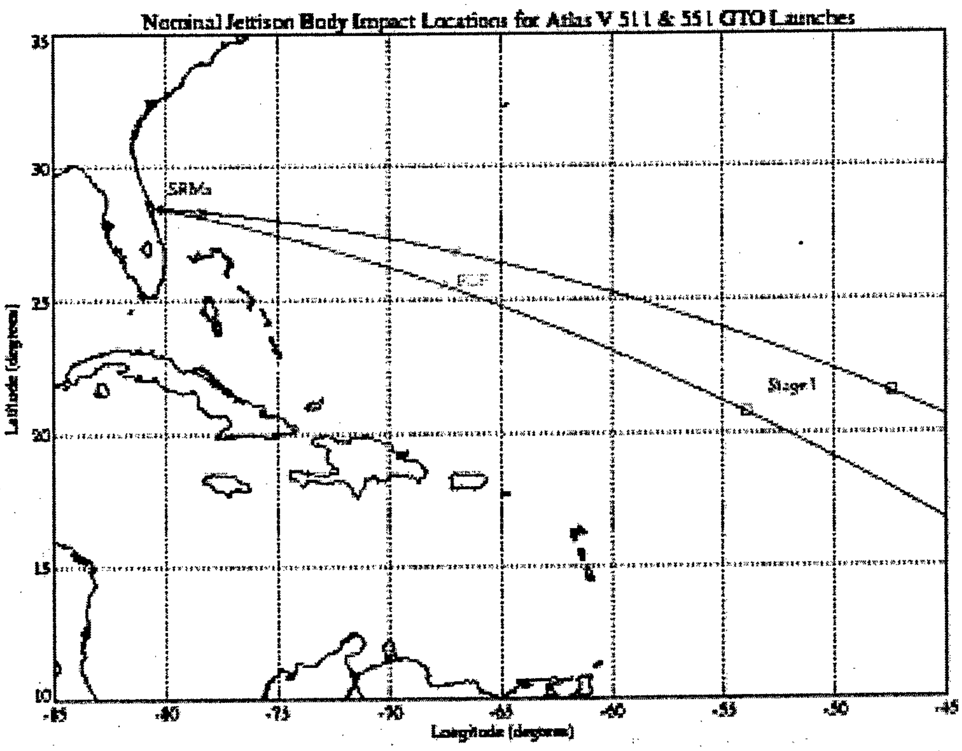
K.R. Bohman, Vehicle Systems Division, The Aerospace Corporation, Aerospace Report No. TOR-99 (1103)-2, September, 1999.

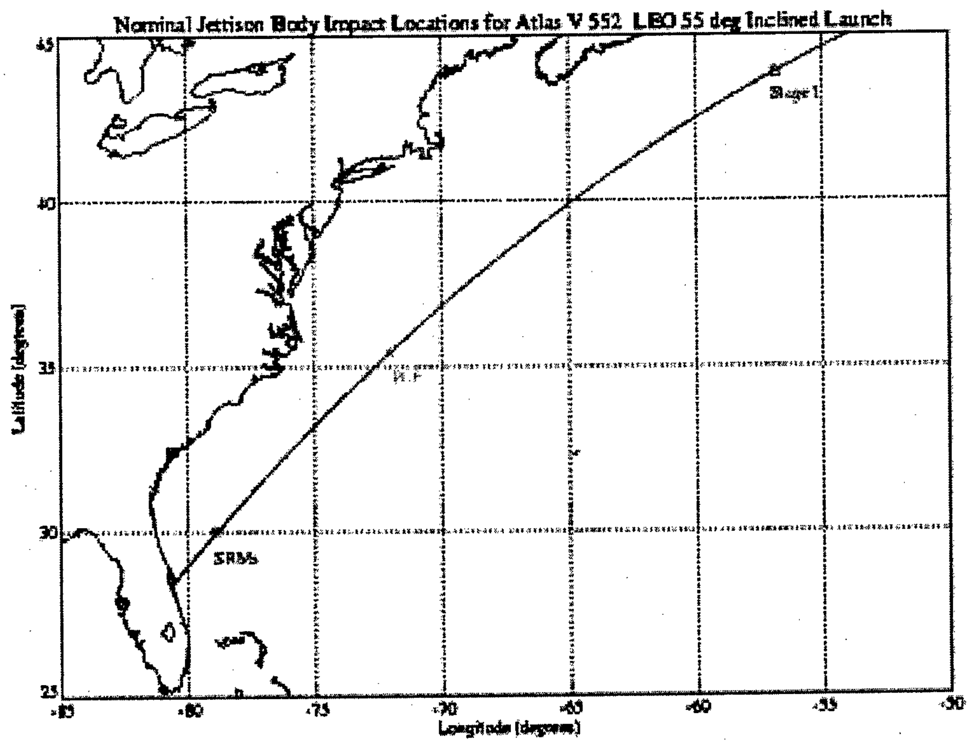
Jettisoned Body Analysis

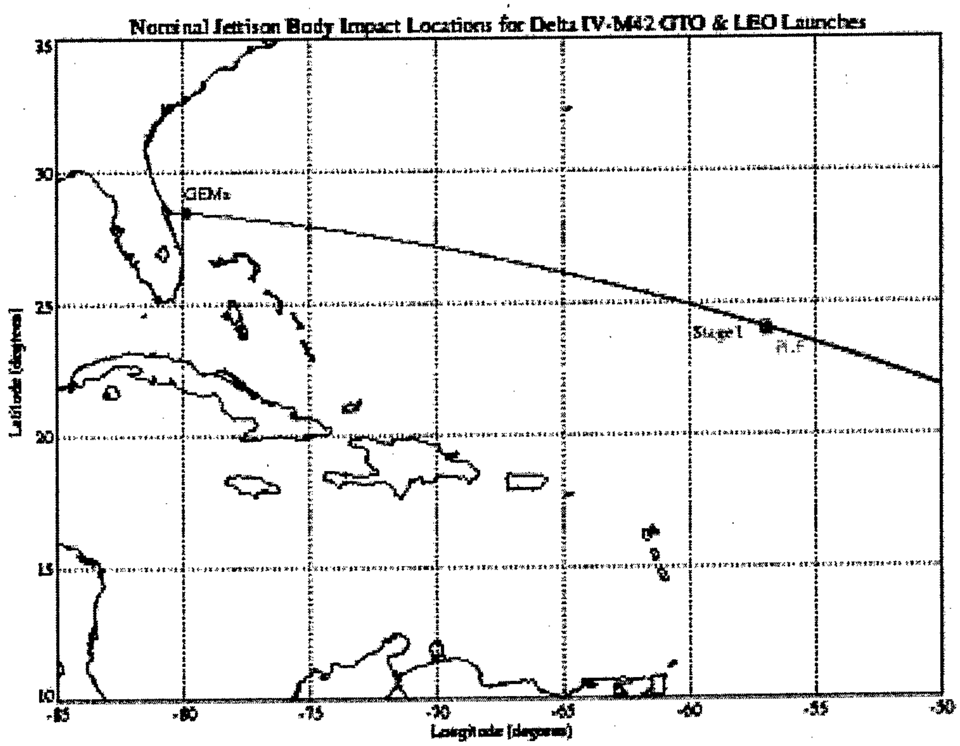
Using ascent trajectory data provided by the contractor, nominal drag impact locations for the launch vehicle jettisoned bodies were determined by trajectory simulation. The solid motor casings, spent core stage, and payload fairing for each Evolved Expendable Launch Vehicle (EELV) configuration were assumed to have similar aerodynamic characteristics as current launch vehicle jettisoned bodies that have similar length to diameter ratios. Thus, tumbling drag coefficients that are used for current launch vehicle range safety analyses (References [1]&[2]) were applied to EELV jettisoned bodies with the appropriate scaling of the aerodynamic reference area and using appropriate jettisoned weights. Separate 3-degree-of-freedom simulations from jettison to surface impact were executed for the Atlas V solid rocket motors (SRMs), the Delta IV solid rocket motors (graphite epoxy motors or GEM 60s), the payload fairings (PLF), and the expended first stages (Stage 1). Note that separation velocities were not modeled. For solid strap-ons and the fairing, the separation velocity is generally of small magnitude and in a lateral direction. Therefore, it would have a very small effect on the calculated impact location. The velocity imparted to the spent core stage could be significant and in the aft direction. If so, the expected impact location would shift uprange by about 10 to 20 nautical miles. The Eastern Range refers to launches from Cape Canaveral Air Force Station and the Western Range refers to launches from Vandenberg Air Force Base.

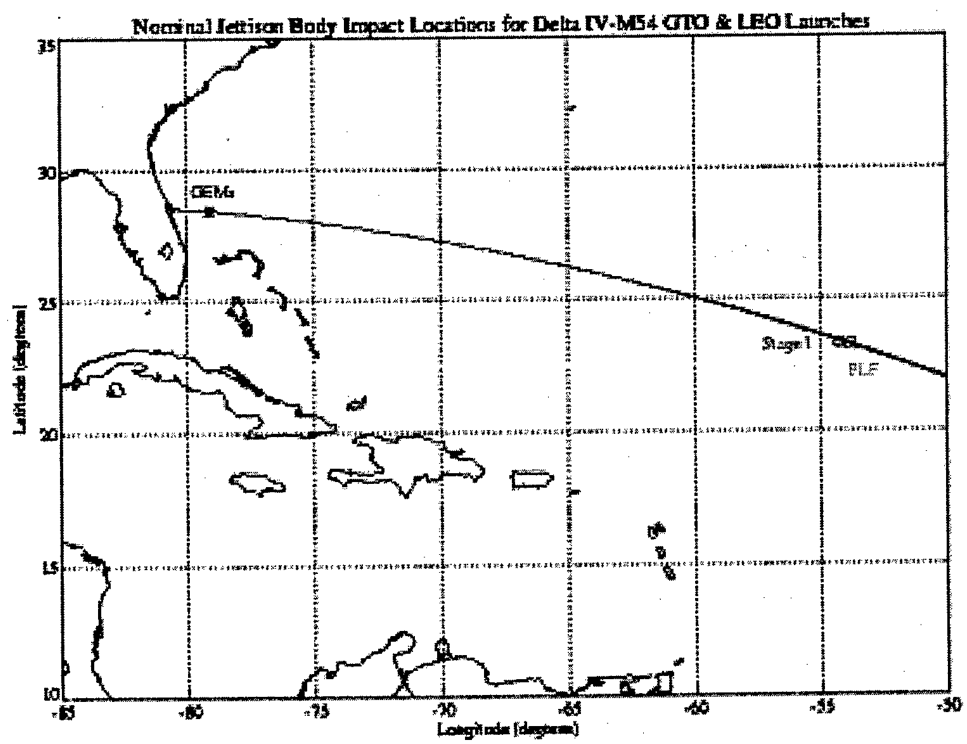
Nominal (No-Wind) Impact Locations for the Atlas V with SRMs and the Delta IV with the larger GEMs: Eastern Range

Vehicle Configuration & Mission	Jettisoned Body	Latitude	Longitude
Atlas V 511 GTO	SRM	28.559	-80.250
	PLF	25.672	-67.497
	Stage 1	20.889	-53.938
Atlas V 551 GTO	SRMs	28.450	-78.629
	PLF	26.890	-66.870
	Stage 1	21.670	-47.438
Atlas V 552 55 deg Inclined	SRMs	30.006	-78.941
	PLF	35.536	-72.083
	Stage 1	43.941	-56.783
Delta IV-M+(4,2) GTO	GEMs	28.472	-79.876
	PLF	24.068	-56.921
	Stage 1	23.980	-56.875
Delta IV-M+(5,4) GTO	GEMs	28.446	-79.154
	PLF	23.289	-54.205
	Stage 1	23.314	-54.294


Nominal Jettison Body Impact Locations for Atlas V 511 & 551 GTO Launches
SRMs
PLF
Stage 1
Latitude (degrees)
Longitude (degrees)
35
30
25
20
15
10
-85
-80
-75
-70
-65
-60
-55
-50
-45


Nominal Jettison Body Impact Locations for Atlas V 552 LEO 55 deg Inclined Launch
Stage 1
PLF
SRMs
Latitude (degrees)
Longitude (degrees)
45
40
35
30
25
-85
-80
-75
-70
-65
-60
-55
-50





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Nominal (No-Wind) Impact Locations for the Atlas V with SRMs and the Delta IV with the larger GEMs: Western Range

Vehicle Configuration & Mission	Jettisoned Body	Latitude	Longitude
Atlas V 512 Inclined	SRM	33.684	-120.075
	PLF	25.576	-116.061
	Stage 1	19.635	-113.443
Atlas V 512 Polar	SRM	33.722	-120.638
	PLF	24.763	-121.116
	Stage 1	18.540	-121.648
Atlas V 552 Inclined	SRMs	32.785	-119.671
	PLF	23.193	-115.509
	Stage 1	13.095	-111.889
Atlas V 552 Polar	SRMs	32.624	-120.711
	PLF	22.656	-121.388
	Stage 1	11.343	-122.073
Delta IV-M+(4,2) Inclined	GEMs	33.202	-119.753
	PLF	13.871	-110.621
	Stage 1	13.632	-110.528
Delta IV-M+(4,2) Polar	GEMs	33.150	-120.899
	PLF	12.210	-124.976
	Stage 1	12.304	-124.955
Delta IV-M+(5,4) Inclined	GEMs	33.477	-119.831
	PLF	11.154	-108.671
	Stage 1	11.264	-108.716
Delta IV-M+(5,4) Polar	GEMs	33.232	-120.649
	PLF	10.638	-122.041
	Stage 1	10.709	-122.035

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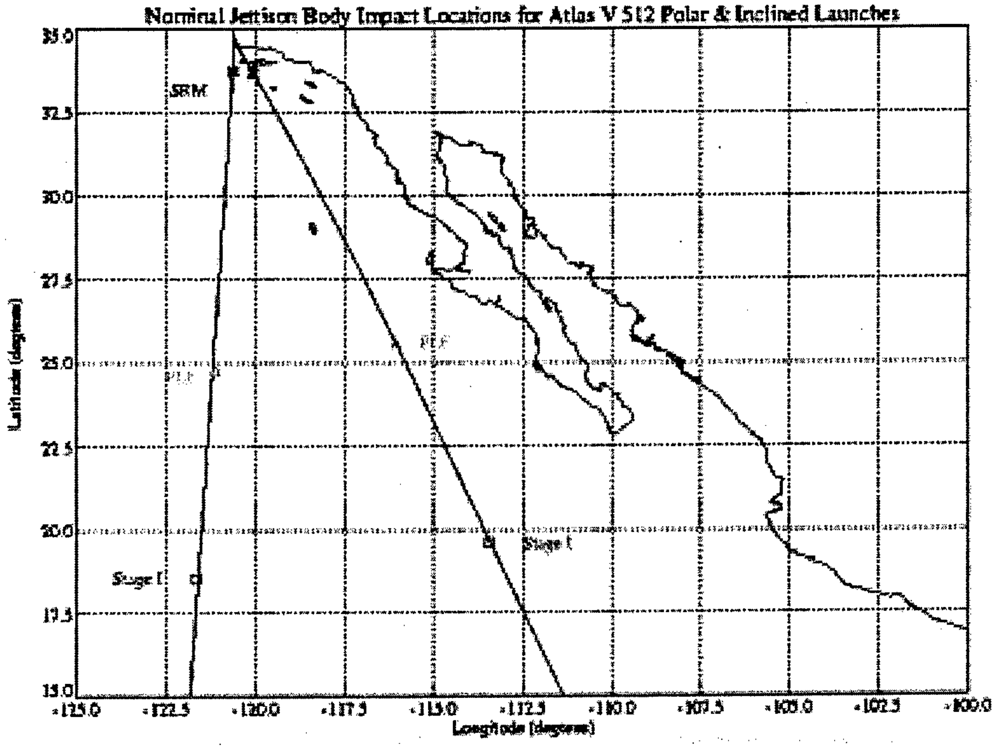
Nominal Jettison Body Impact Locations for Atlas V 512 Polar & Inclined Launches
SRM
PLF
PLF
Stage I
Stage I
Latitude (degrees)
Longitude (degrees)
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
-125.0
-122.5
-120.0
-117.5
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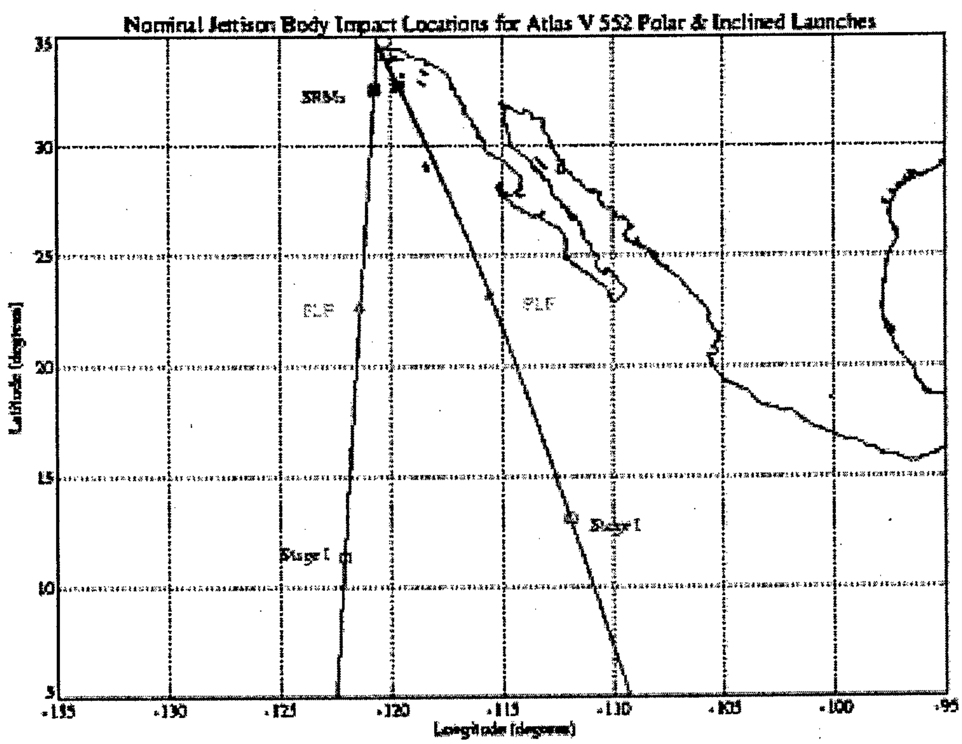
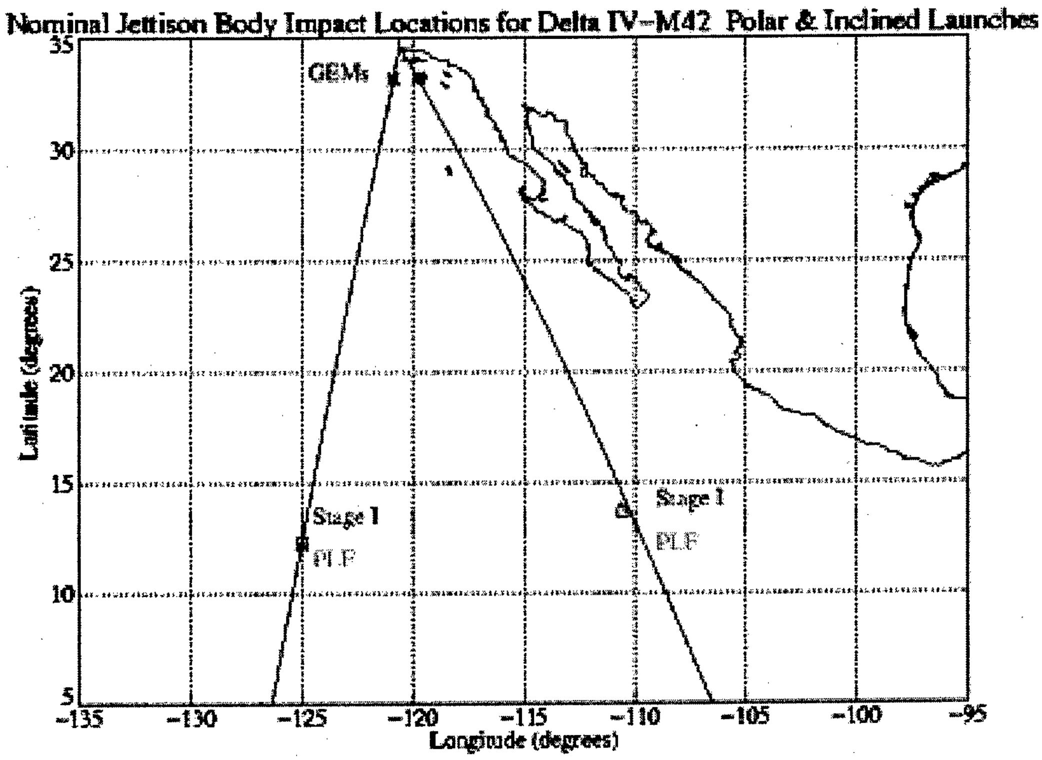
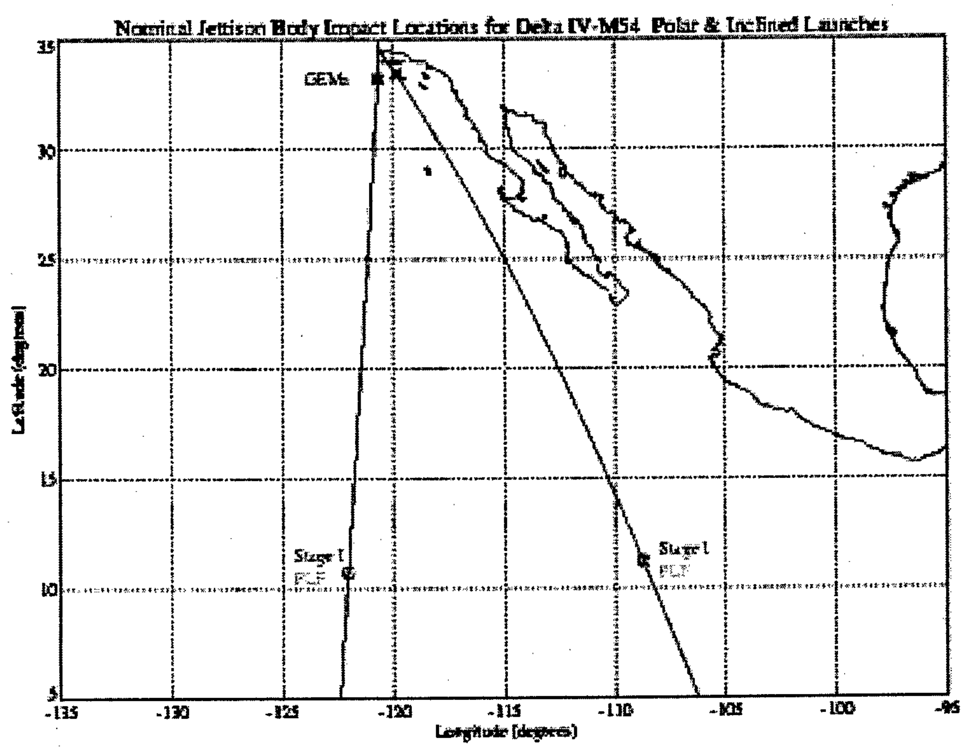
-100.0


Nominal Jettison Body Impact Locations for Atlas V 552 Polar & Inclined Launches
SRMs
PLF
PLF
Stage I
Stage I
Latitude (degrees)
Longitude (degrees)
35
30
25
20
15
10
5
-135
-130
-125
-120
-115
-110
-105
-100
-95





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Obviously, the actual jettisoned body impact locations are dependent on the day-of-launch conditions and trajectory. Therefore, jettisoned body impact ellipses are constructed via downrange and crossrange dispersion distances from the nominal impact point. The dispersion distances may be determined by simulating the vehicle performance and wind effects separately and then root sum squaring (RSS) the results together. For this study, notional performance dispersion distances were applied based on experience from other launch vehicles (References [2]&[3]). Wind effects were determined by simulating the jettisoned body's fall through a 99 percent outer profile wind. In each case (headwind, tailwind, left and right crosswinds) the wind was adjusted for azimuth using the appropriate wind rose factor. For this analysis the primary concern was the potential impact region just off the coast, thus, only solid motor jettison ellipses were estimated. The following tables show the estimated dimensions for the SRM/GEM impact ellipses for various EELV configurations involving the use of solid motors.

SRM Drag Impact Dispersion Distances from Nominal SRM Impact Locations

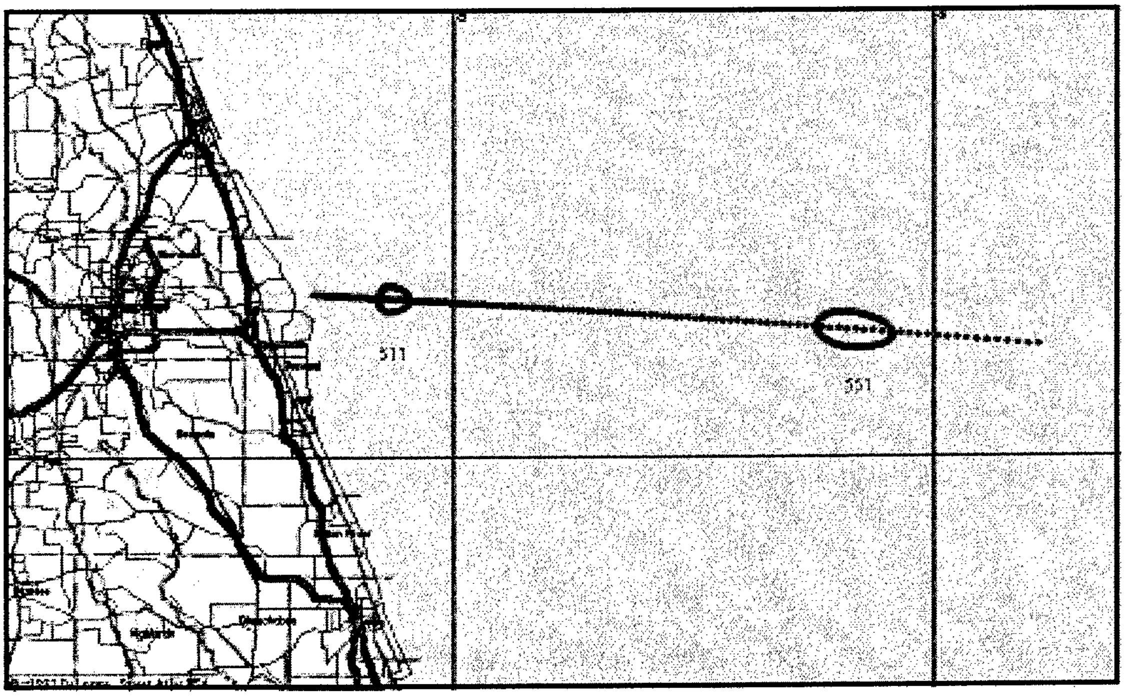
Atlas V 511 ER GTO				
	Downrange (nmi)	**Uprange (nmi)**	**Left (nmi)**	**Right (nmi)**
Performance dispersions*	1	1	0.3	0.3
Wind effects	4.6	1.6	2.9	2.7
RSSed total	4.7	1.9	2.9	2.7

Atlas V 551 ER GTO				
	Downrange (nmi)	**Uprange (nmi)**	**Left (nmi)**	**Right (nmi)**
Performance dispersions*	4	4	1.5	1.5
Wind effects	6.6	2.4	3.6	3.3
RSSed total	7.7	4.7	3.9	3.6

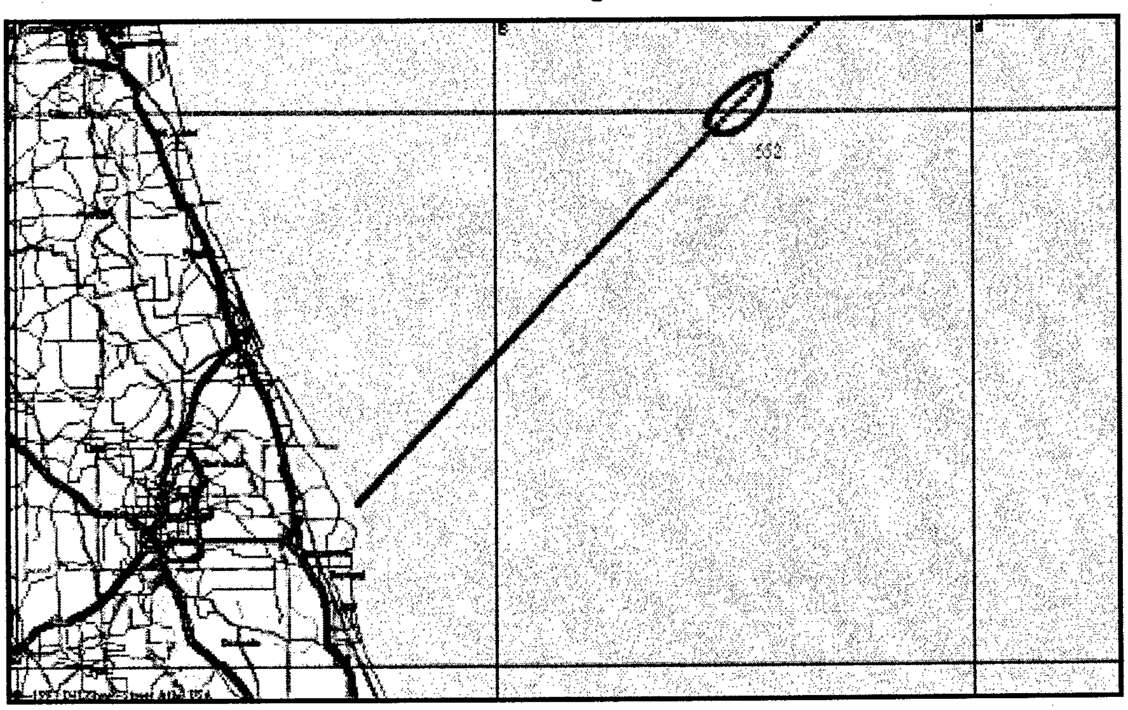
Atlas V 552 ER LEO Inclined				
	Downrange (nmi)	**Uprange (nmi)**	**Left (nmi)**	**Right (nmi)**
Performance dispersions*	4	4	1.5	1.5
Wind effects	6.7	2.9	2.1	4.8
RSSed total	7.8	4.9	2.6	5.0

*Performance dispersions are estimated based on related studies for other launch vehicles

Estimated Solid Motor Impact Ellipses
Atlas V 511 and 551 GTO Launches



Estimated Solid Motor Impact Ellipses
Atlas V 552 LEO 55 deg Inclined Launch



SRM Drag Impact Dispersion Distances from Nominal SRM Impact Locations

Atlas V 512 WR Inclined

	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	4.8	2.3	4.7	1.9
RSSed total	5.7	3.8	4.8	2.1

Atlas V 512 WR Polar

	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	3.8	3.1	5.0	1.7
RSSed total	4.8	4.3	5.1	2.0

Atlas V 552 WR Inclined

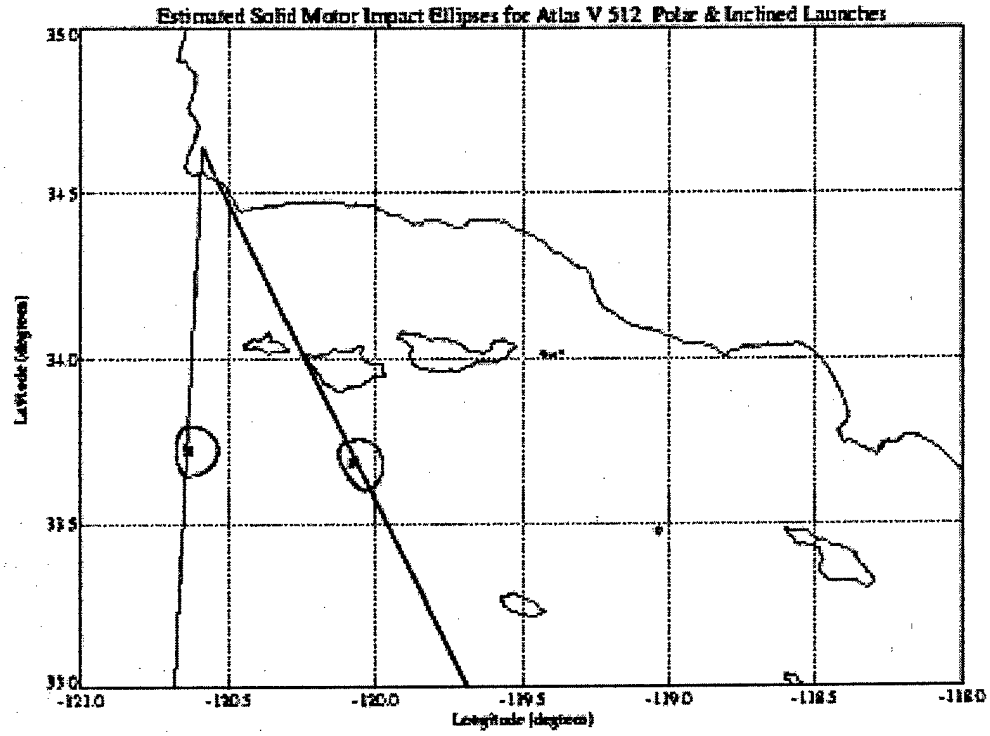
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	4	4	1.5	1.5
wind effects	7.8	4.8	5.2	2.1
RSSed total	8.8	6.2	5.4	2.6

Atlas V 552 WR Polar

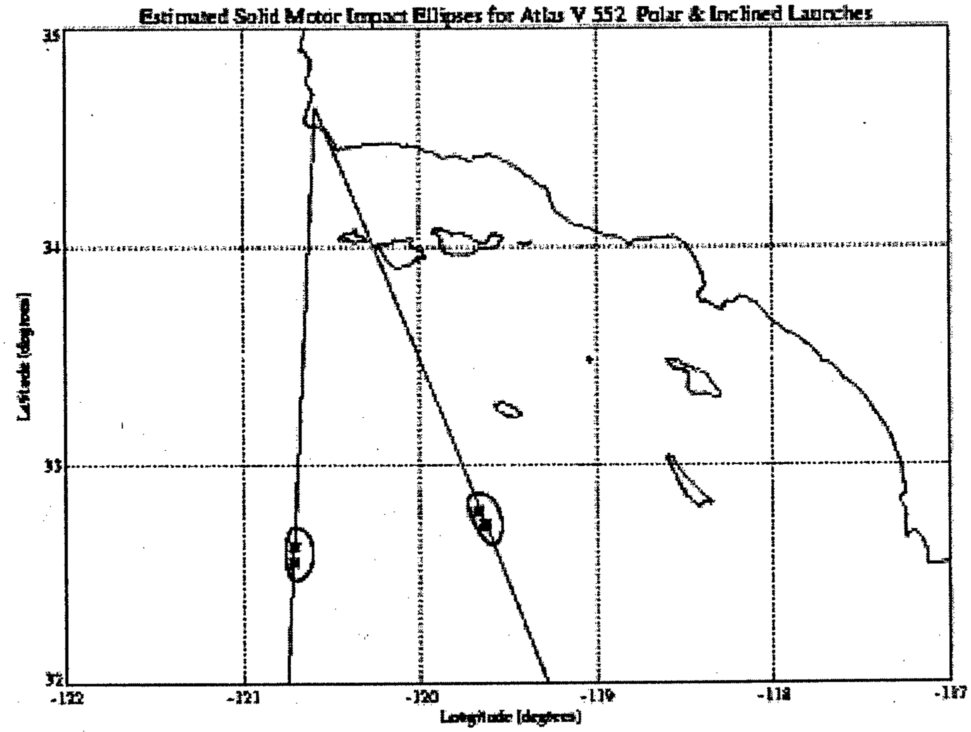
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	4	4	1.5	1.5
Wind effects	6.5	5.7	5.3	1.8
RSSed total	7.6	7.0	5.5	2.3

*Performance dispersions are estimated based on related studies for other launch vehicles

Estimated Solid Motor Impact Ellipses for Atlas V 512 Polar & Inclined Launches



Estimated Solid Motor Impact Ellipses for Atlas V 552 Polar & Inclined Launches



Current restrictions of over-flight of Channel Islands requires nominal trajectory of IIP west of Santa Rosa Island. All azimuths proposed will be evaluated by Flight Safety Officer to ensure acceptable risk levels for general public are not exceeded.

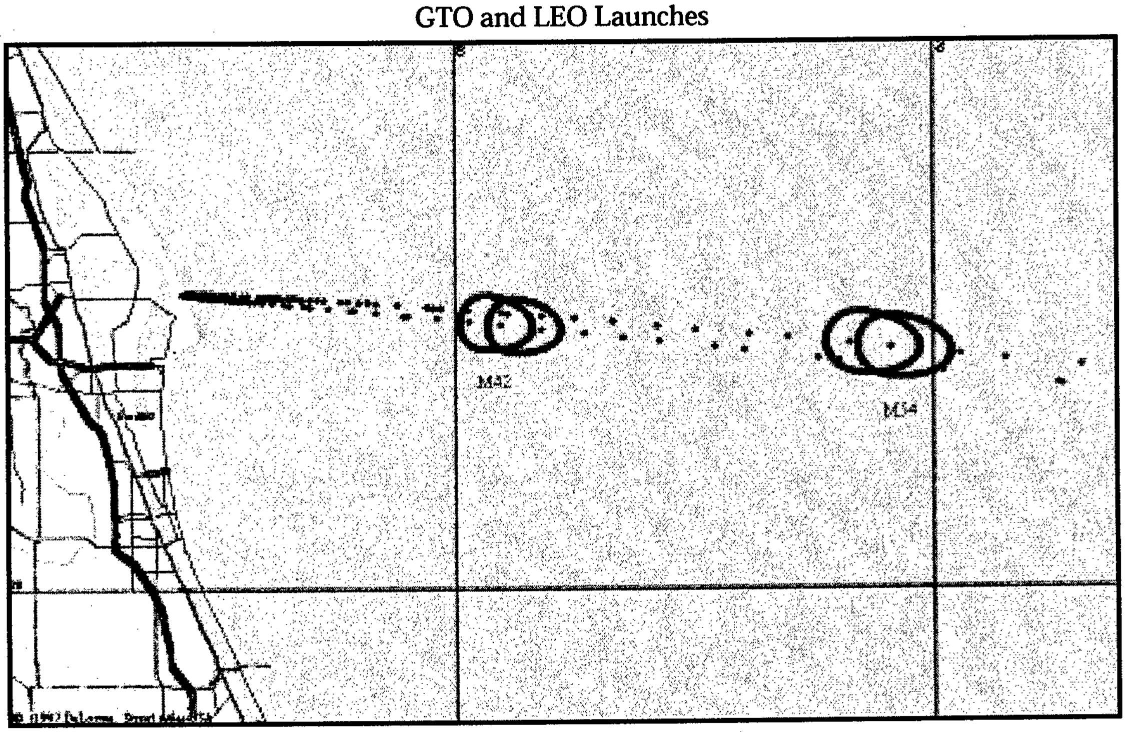
GEM Drag Impact Dispersion Distances from Nominal GEM Impact Locations

Delta IV-M+ (4,2) ER GTO				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	2	2	0.5	0.5
Wind effects	5.0	1.8	3.0	2.8
RSSed total	5.4	2.7	3.1	2.8

Delta IV-M+ (5,4) ER GTO				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	6.0	2.1	3.3	3.1
RSSed total	6.7	3.7	3.4	3.3

*Performance dispersions are estimated based on related studies for other launch vehicles

Estimated Solid Motor Impact Ellipses
Delta IV-M42 and M54
GTO and LEO Launches



GEM Drag Impact Dispersion Distances from Nominal GEM Impact Locations

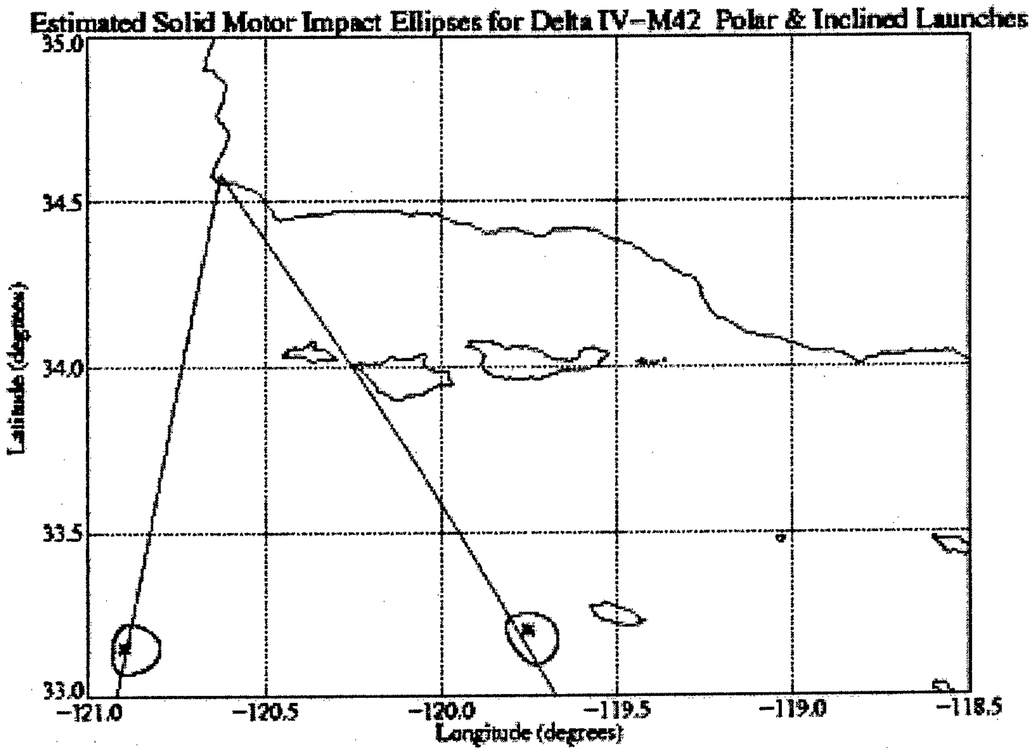
Delta IV-M+ (4,2) WR Inclined				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	5.0	2.4	4.7	1.9
RSSed total	5.8	3.8	4.8	2.1

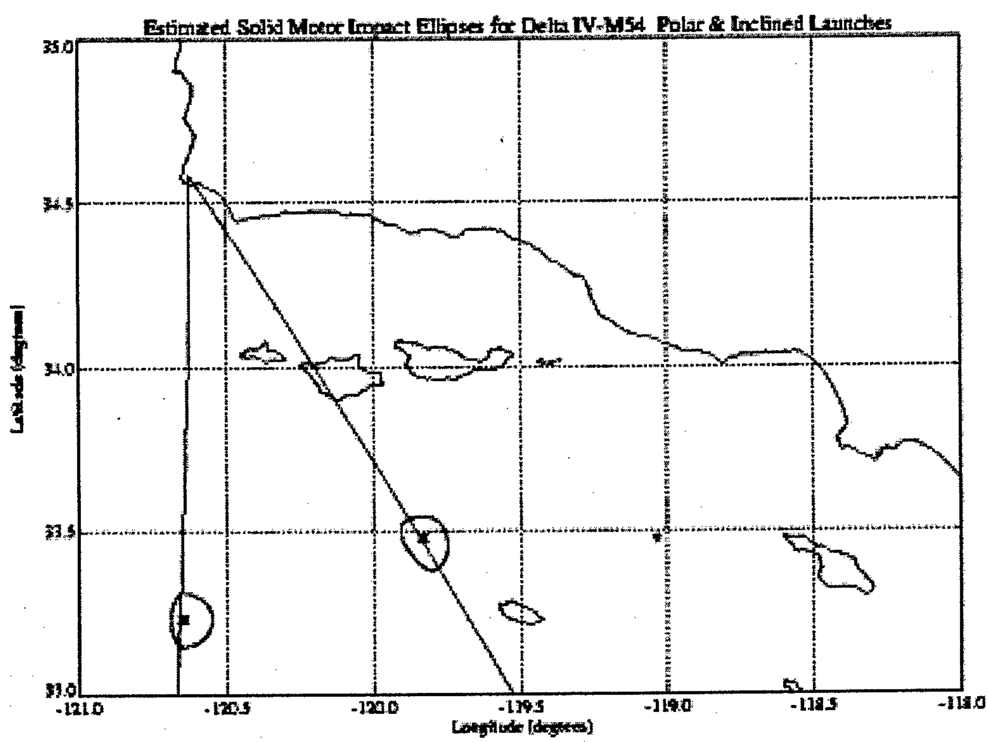
Delta IV-M+ (4,2) WR Polar				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	3.8	3.1	4.8	1.6
RSSed total	4.8	4.3	4.9	1.9

Delta IV-M+ (5,4) WR Inclined				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	5.4	2.6	4.9	2.0
RSSed total	6.2	4.0	5.0	2.2

Delta IV-M+ (5,4) WR Polar				
	Downrange (nmi)	Uprange (nmi)	Left (nmi)	Right (nmi)
Performance dispersions*	3	3	1	1
Wind effects	4.2	3.4	5.0	1.7
RSSed total	5.2	4.5	5.1	2.0

*Performance dispersions are estimated based on related studies for other launch vehicles





Current restrictions of over-flight of Channel Islands requires nominal trajectory of IIP west of Santa Rosa Island. All azimuths proposed will be evaluated by Flight Safety Officer to ensure acceptable risk levels for general public are not exceeded.

Debris Footprint Analysis

For any space launch vehicle, there is the possibility of a launch failure early in flight. Hence, there is a risk of vehicle debris impacting the region surrounding the launch site as well as areas downrange of the launch site. The vehicle location, speed, and direction at the time of the explosion as well as the current wind conditions would largely determine a debris footprint from an actual failure. To generate a typical debris footprint that may occur from a launch failure, simulations of fragment trajectories were run using parameters that are consistent with current launch vehicle debris models. The fragments (with ballistic coefficients ranging between 2 and 400 psf) were initialized at some nominal, on-trajectory state, with a randomly selected induced velocity (between 0 and 200 fps in any direction) and then propagated to ground impact in the presence of a mean, annual wind model. Under these assumptions, simulation results show that the debris patterns generally lie on the Air Force Base/Station or just offshore. On the Western Range there is some risk of debris impacting the Point Conception area. More extreme wind conditions could result in debris footprints lying significantly onshore.

It should be noted that the Space Wing Safety Offices for both eastern and western ranges adhere to an flight plan approval process for each launch vehicle and mission to ensure that the risks associated with launch vehicle operations do not exceed acceptable limits (Reference [4]).

References

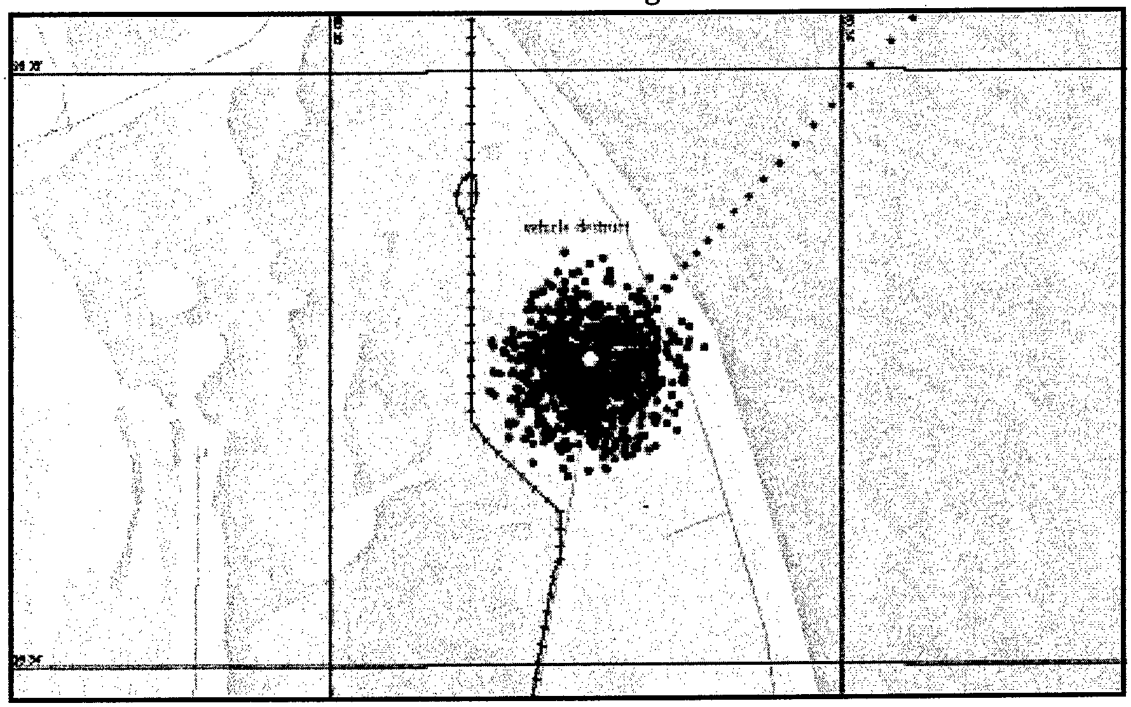
[1] Sica, D.W., Range Safety Data for Titan IVB-24, Volume III: Trajectory/Jettison Body Data, Lockheed Martin Astronautics, MCR-96-8292, September 1996.

[2] Salerno, C.L., Range Safety Data Package For Titan II 23G-7, Lockheed Martin Corporation, MCR-0005-0100, August 1998.

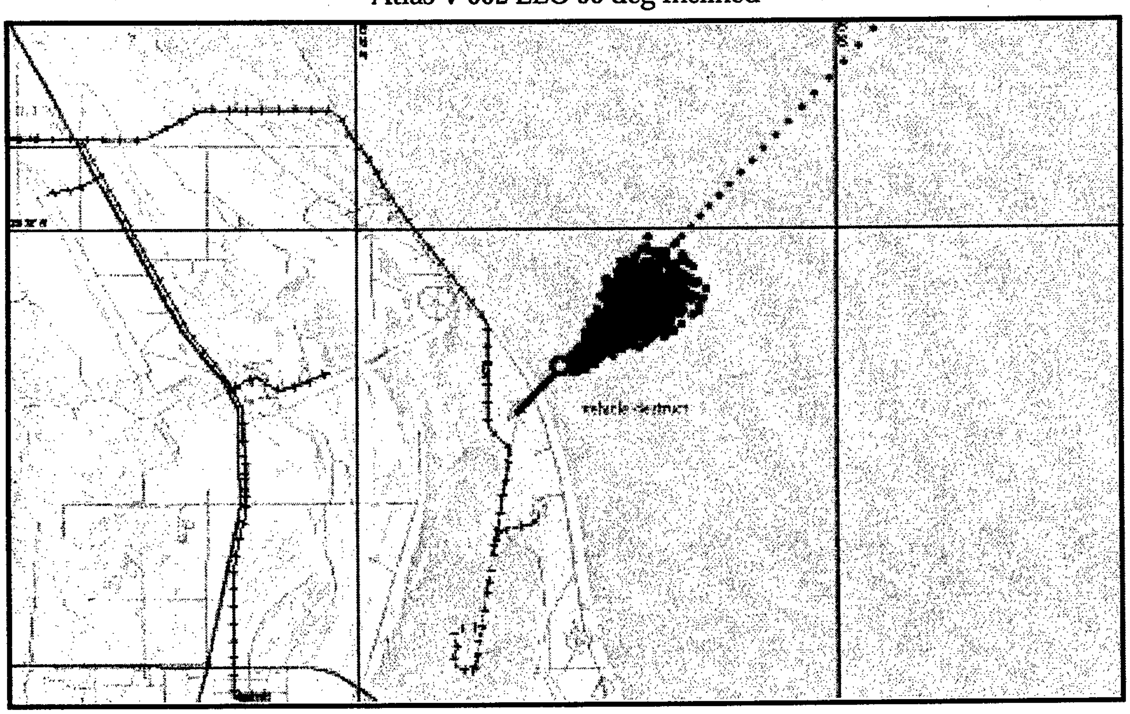
[3] Delvaux, M.J., Titan IVB-12 TAG Range Safety Data Package, Lockheed Martin Corporation, MCR-0005-0133, December 1998.

[4] Flight Safety Analyst Training and General Reference Handbook, 30th Space Wing/ Safety Office, January 1996.

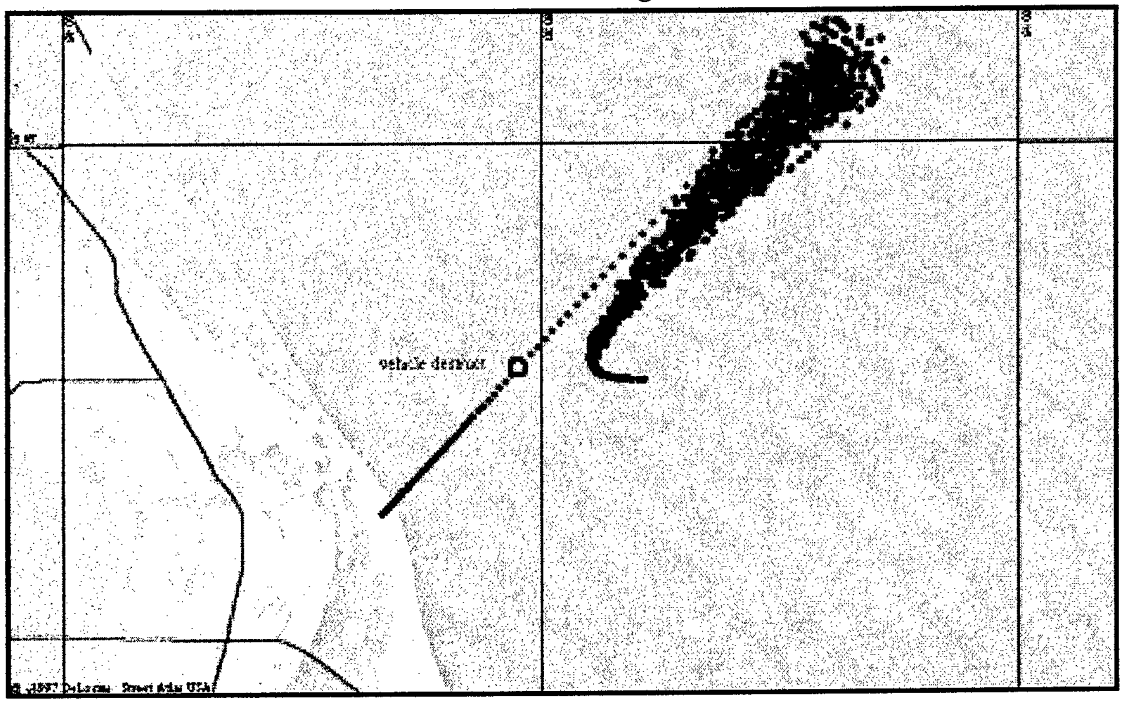
Debris Footprint for On-Trajectory Failure at T + 10 seconds
Mean Annual Wind Profile
Atlas V 552 LEO 55 deg Inclined



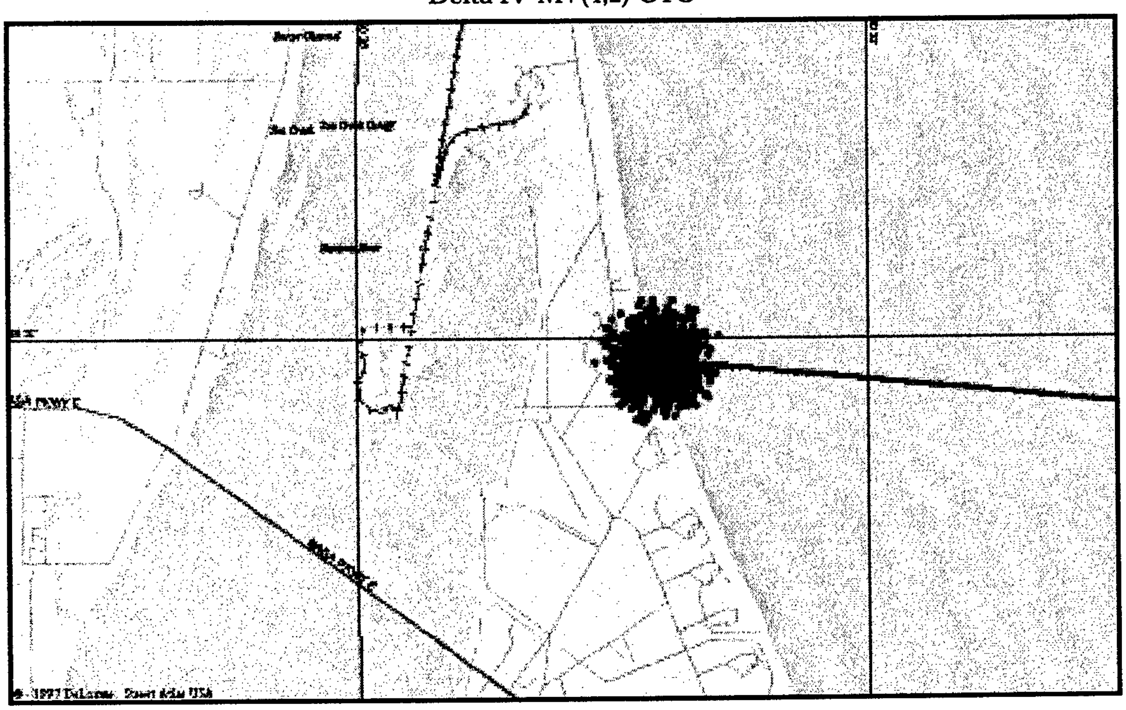
Debris Footprint for On-Trajectory Failure at T + 30 seconds
Mean Annual Wind Profile
Atlas V 552 LEO 55 deg Inclined



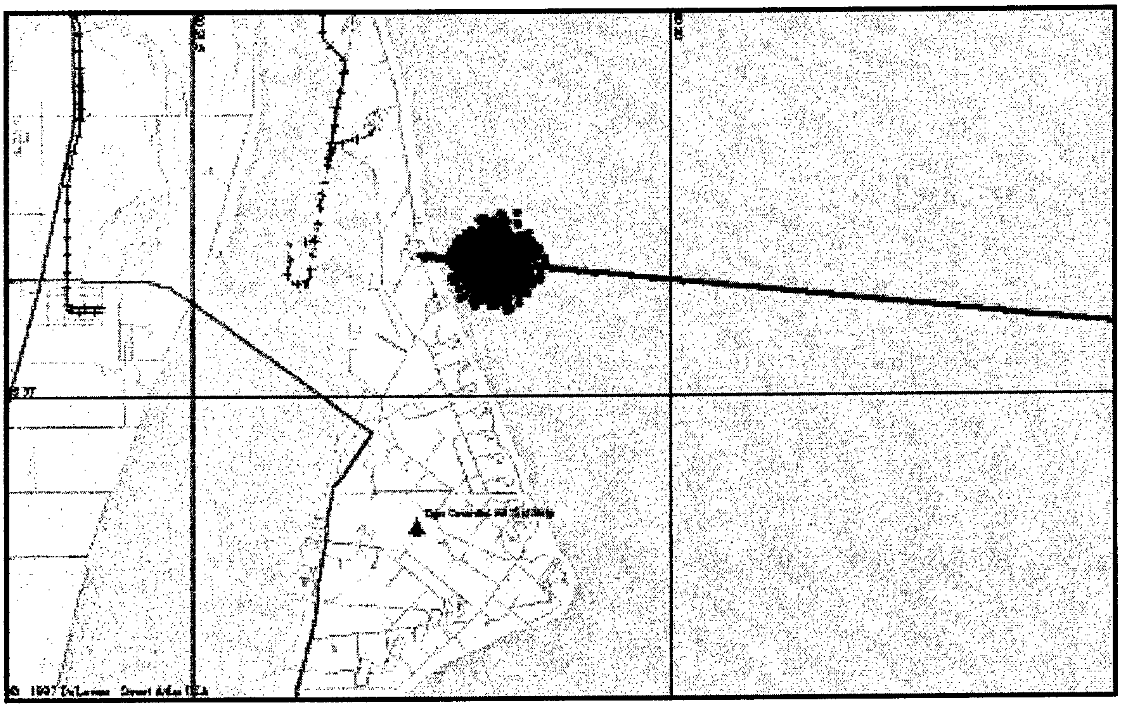
Debris Footprint for On-Trajectory Failure at T + 60 seconds
Mean Annual Wind Profile
Atlas V 552 LEO 55 deg Inclined



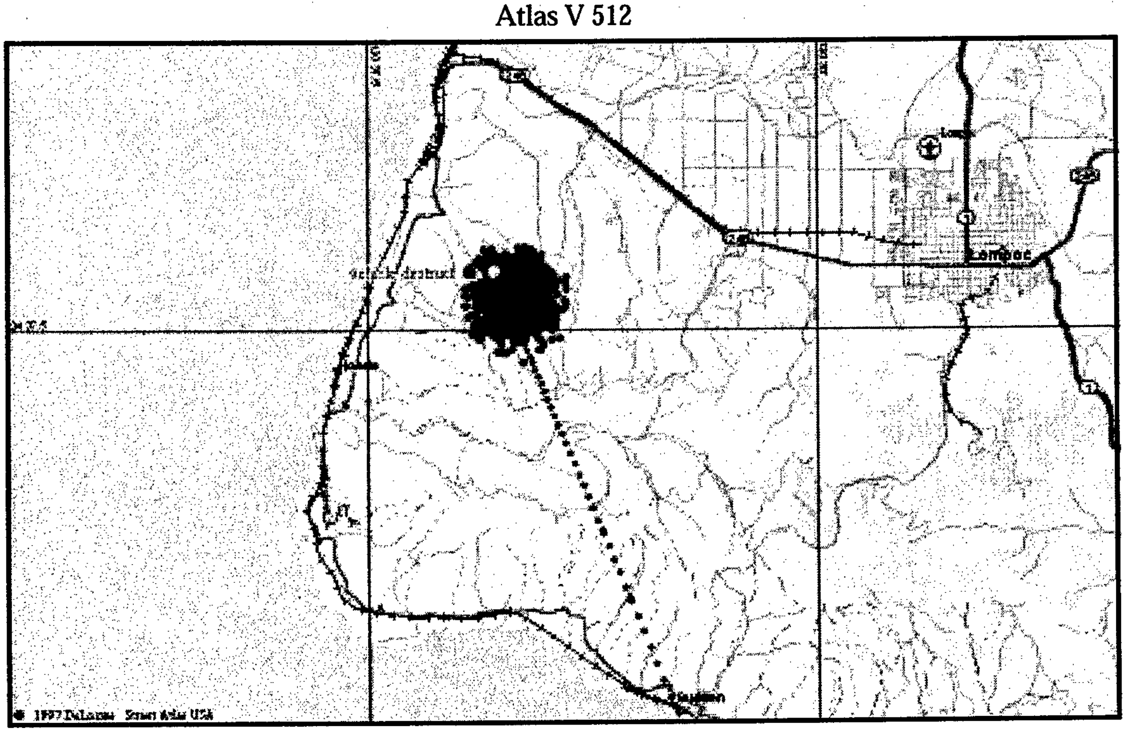
Debris Footprint for On-Trajectory Failure at T + 20 seconds
Mean Annual Wind Profile
Delta IV-M+(4,2) GTO



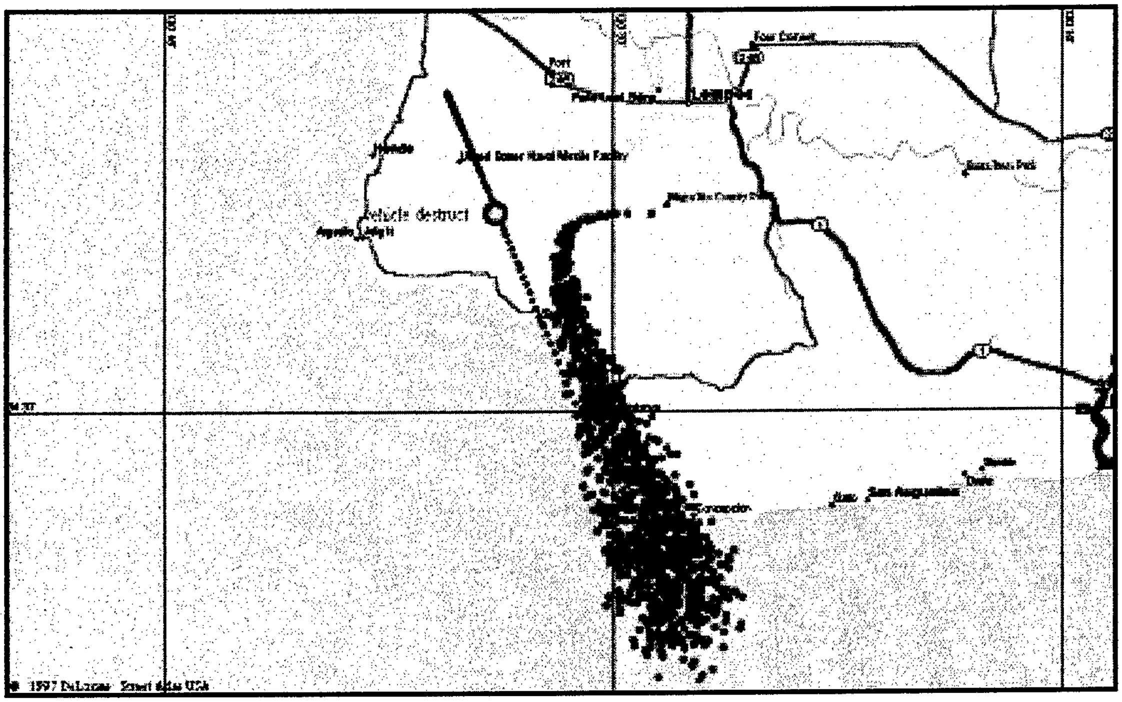
Debris Footprint for On-Trajectory Failure at T + 30 seconds
Mean Annual Wind Profile
Delta IV-M+(4,2) GTO



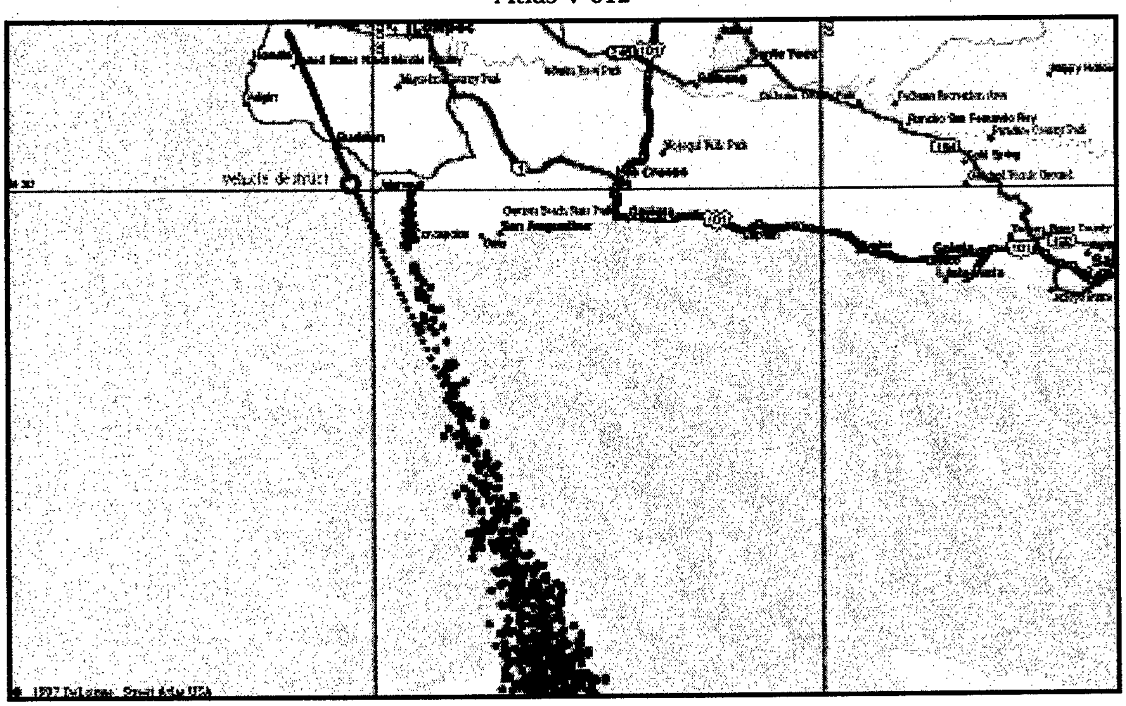
Debris Footprint for On-Trajectory Failure at T + 50 seconds
Mean Annual Wind Profile
Atlas V 512



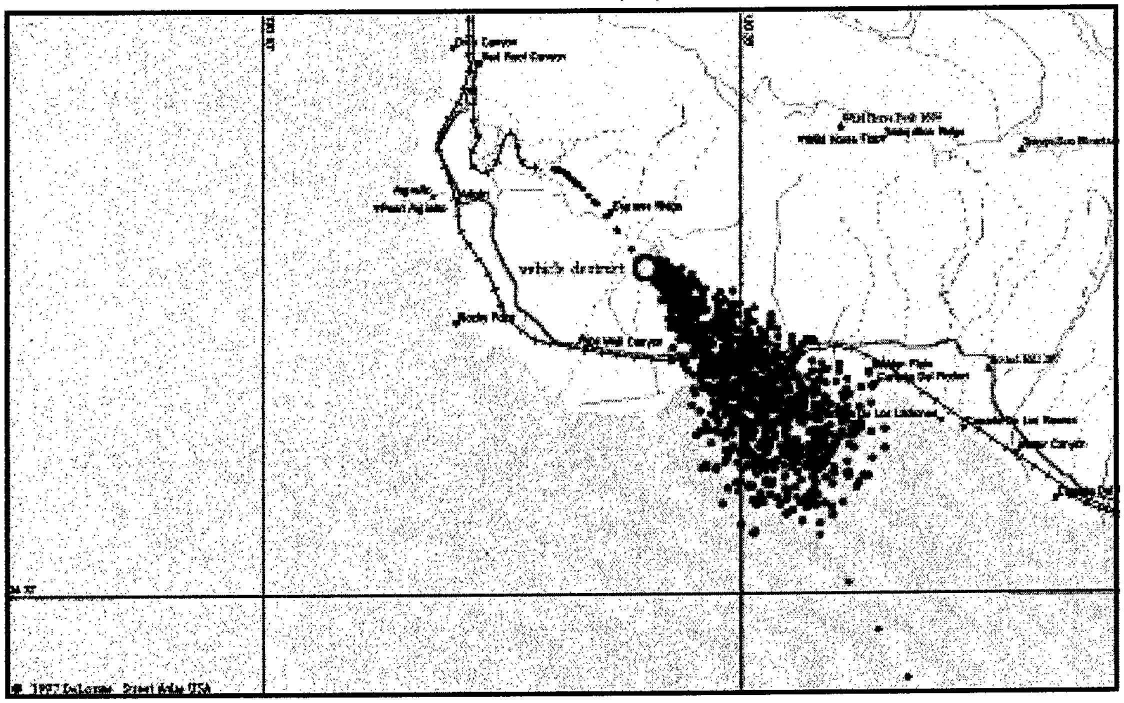
Debris Footprint for On-Trajectory Failure at T + 90 seconds
Mean Annual Wind Profile
Atlas V 512



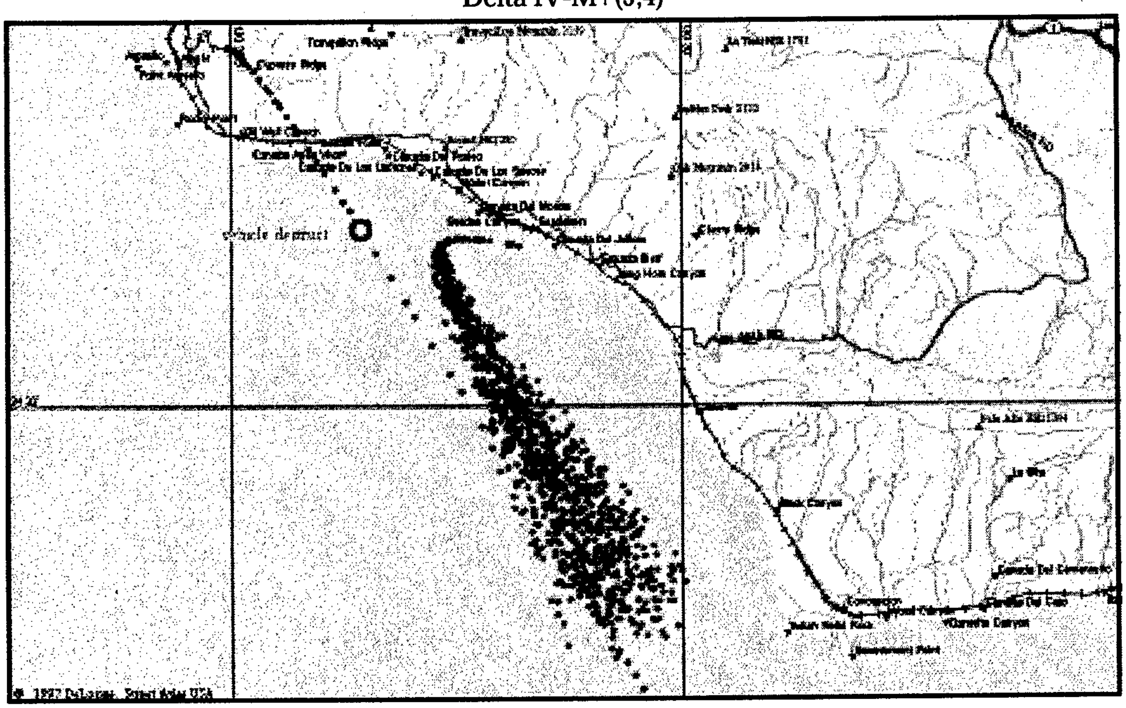
Debris Footprint for On-Trajectory Failure at T + 110 seconds
Mean Annual Wind Profile
Atlas V 512



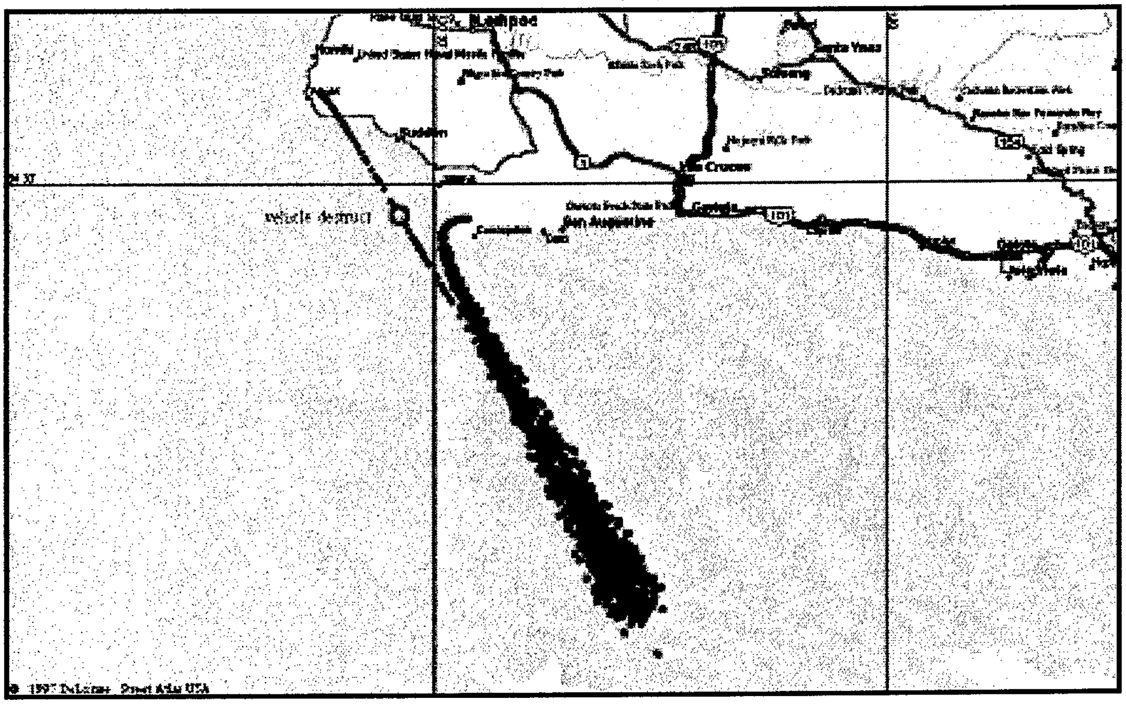
Debris Footprint for On-Trajectory Failure at T + 30 seconds
Mean Annual Wind Profile
Delta IV-M+(5,4)



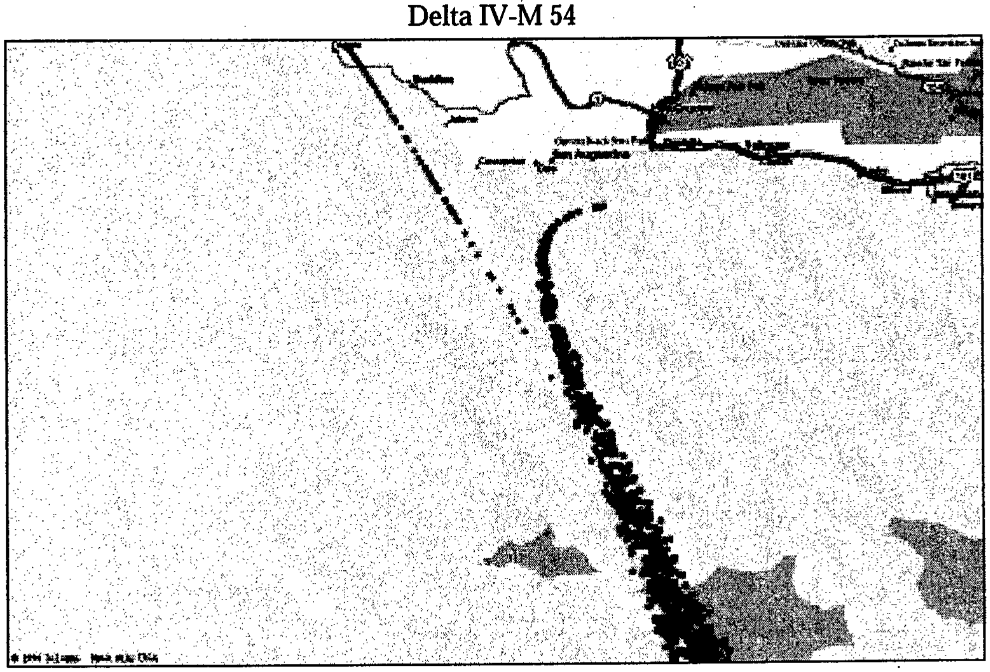
Debris Footprint for On-Trajectory Failure at T + 50 seconds
Mean Annual Wind Profile
Delta IV-M+(5,4)



Debris Footprint for On-Trajectory Failure at T + 70 seconds
Mean Annual Wind Profile
Delta IV-M+(5,4)



Debris Footprint for On-Trajectory Failure at T + 90 seconds
Mean Annual Wind Profile
Delta IV-M 54



Appendix R
Background Water Quality Data

This appendix addresses the potential for acid deposition resulting from the hydrogen chloride (HCl) contained in the exhaust cloud from the solid rocket boosters. For the proposed Evolved Expendable Launch Vehicles (EELVs), appreciable amounts of acid deposition are possible only if rain occurred during or just after a launch. While it is not impossible that an EELV would be launched during rain, other launch commit criteria (such as those designed to protect the launch vehicle and its payload against lightning strikes) make the likelihood for a launch during the rain very low.

Acid Deposition Runs

The following table summarizes the results of running the Rocket Exhaust Effluent Diffusion Model (REEDM) to assess the potential for acid deposition. This model was run for Cape Canaveral Air Force Station (CCAFS) using four different meteorological cases (CCAFS1, CCAFS2, CCAFS3, and CCAFS4) with precipitation rates of 0.1 inch per hour (in/hr) and 0.3 in/hr. Two launch scenarios, a nominal launch and a launch failure, were investigated for each vehicle for each meteorological case. Also, the model was run for Vandenberg Air Force Base (VAFB) using three different meteorological cases (VAFB1, VAFB2, and VAFB3) with precipitation rates of 0.05 in/hr and 0.1 in/hr. Two launch scenarios, a nominal launch and a failed launch, were investigated for each vehicle for each meteorological case. All other parameters are the same as those used in REEDM runs for the air quality analysis (see Appendix T).

It is important to note two key features of the REEDM rain washout modeling: the results do not provide information for locations near the launch sites and the results are indicative of the upper portion of the range of potential acid deposition amounts.

Two phases of the REEDM calculations are first the rise, and eventual stabilization, of the ground cloud of the exhaust from the launch vehicle and second the transport and diffusion of the stabilized cloud downwind. The rain washout (i.e., precipitation scavenging) module of REEDM models the removal of hydrogen chloride gas from the exhaust cloud during this second phase, the transport and diffusion of the stabilized ground cloud. As a consequence, there are no REEDM calculations for acid deposition for locations closer to the launch site than the distance at which the ground cloud reaches its stabilization height. For the cases presented here, stabilization occurs at distances between 1,000 meters and 3 kilometers. Furthermore, following the procedure in Appendix T, REEDM results closer than 1 kilometer were not calculated. Consequently, for the cases presented here, the REEDM rain washout results that could occur nearest to the launch sites are at distances of from 1,000 meters to 3 kilometers.

TABLE R-1
REEDM Acid Deposition Run Summary

Vehicle	Precipitation (in/hr)	Meteorological Case	Launch Site	Duration (min)	Al_2O_3 (mg/m²)	pH	HCl deposited (mg/m²)	$CaCO_3$ consumed (mg/L)
Normal Launches								
Atlas V Medium w/ solids	0.1	CCAFS1	CCAFS	6.4	2,067	0.158	6,862	94
	0.1	CCAFS2	CCAFS	10.1	3,891	0.364	6,730	92
	0.1	CCAFS3	CCAFS	5.4	1,965	0.311	4,053	56
	0.1	CCAFS4	CCAFS	5.2	2,282	0.498	2,552	35
	0.3	CCAFS1	CCAFS	6.4	3,942	0.355	13,080	179
	0.3	CCAFS2	CCAFS	10.1	7,265	0.568	12,622	173
	0.3	CCAFS3	CCAFS	5.4	3,731	0.508	7,725	106
	0.3	CCAFS4	CCAFS	5.2	4,279	0.696	4,854	67
Delta IV Medium w/ 4 solids	0.1	CCAFS1	CCAFS	7.8	1,410	0.22	7,276	100
	0.1	CCAFS2	CCAFS	9.7	2,414	0.54	4,323	59
	0.1	CCAFS3	CCAFS	4.4	1,537	0.32	3,221	44
	0.1	CCAFS4	CCAFS	5.8	1,264	0.74	1,638	22
	0.3	CCAFS1	CCAFS	7.8	2,687	0.41	14,094	193
	0.3	CCAFS2	CCAFS	9.7	4,525	0.75	7,996	110
	0.3	CCAFS3	CCAFS	4.4	2,927	0.51	6,240	86
	0.3	CCAFS4	CCAFS	5.8	2,377	0.94	3,101	43

TABLE R-1
REEDM Acid Deposition Run Summary

Vehicle	Precipitation (in/hr)	Meteorological Case	Launch Site	Duration (min)	Al_2O_3 (mg/m^2)	pH	HCl deposited (mg/m^2)	$CaCO_3$ consumed (mg/L)
Atlas V Medium w/ solids	0.05	VAFB1	VAFB	1.7	957	0.003	1,316	18
	0.05	VAFB2	VAFB	2.9	3,677	0.021	2,150	29
	0.05	VAFB3	VAFB	7.2	3,170	0.015	5,376	74
	0.1	VAFB1	VAFB	1.7	1,442	0.033	2,455	34
	0.1	VAFB2	VAFB	3.9	5,520	0.027	5,683	78
	0.1	VAFB3	VAFB	7.2	4,774	0.138	8,100	111
Delta IV Medium w/ 4 solids	0.05	VAFB1	VAFB	2.4	580	0.207	1,168	16
	0.05	VAFB2	VAFB	2.0	2,863	0.018	1,495	21
	0.05	VAFB3	VAFB	5.3	2,559	0.055	3,615	50
	0.1	VAFB1	VAFB	2.4	875	0.329	1,764	24
	0.1	VAFB2	VAFB	2.0	4,300	0.142	2,247	31
	0.1	VAFB3	VAFB	5.3	3,853	0.179	5,434	75
Launch Failures								
Atlas V Medium w/ solids	0.1	CCAFS1	CCAFS	2.4	2,565	0.893	464	6
	0.1	CCAFS2	CCAFS	6.0	4,684	0.968	993	14
	0.1	CCAFS3	CCAFS	12.5	2,380	1.011	1,883	26
	0.1	CCAFS4	CCAFS	12.0	3,065	1.038	1,697	23
	0.3	CCAFS1	CCAFS	2.4	4,737	1.104	857	12
	0.3	CCAFS2	CCAFS	6.0	8,161	1.199	1,750	24
	0.3	CCAFS3	CCAFS	12.5	4,356	1.226	3,444	47
	0.3	CCAFS4	CCAFS	12.0	5,512	1.260	3,054	42

TABLE R-1
REEDM Acid Deposition Run Summary

Vehicle	Precipitation (in/hr)	Meteorological Case	Launch Site	Duration (min)	Al_2O_3 (mg/m^2)	pH	HCl deposited (mg/m^2)	$CaCO_3$ consumed (mg/L)
Delta IV Medium w/ 4 solids	0.1	CCAFS1	CCAFS	1.9	1,248	1.67	63	1
	0.1	CCAFS2	CCAFS	6.3	2,257	0.94	1,124	15
	0.1	CCAFS3	CCAFS	6.5	1,509	1.13	747	10
	0.1	CCAFS4	CCAFS	5.2	2,567	0.86	1,099	15
	0.3	CCAFS1	CCAFS	1.9	2,315	1.38	369	5
	0.3	CCAFS2	CCAFS	6.3	4,173	1.16	2,031	28
	0.3	CCAFS3	CCAFS	6.5	2,784	1.34	1,381	19
	0.3	CCAFS4	CCAFS	5.2	4,756	1.07	2,033	28
Atlas V Medium w/ solids	0.05	VAFB1	VAFB	5.9	1,056	0.829	674	9
	0.05	VAFB2	VAFB	8.1	2,882	0.618	1,512	21
	0.05	VAFB3	VAFB	5.3	4,122	0.318	1,950	27
	0.1	VAFB1	VAFB	5.9	1,579	0.955	1,008	14
	0.1	VAFB2	VAFB	8.1	4,278	0.740	2,283	31
	0.1	VAFB3	VAFB	5.3	6,150	0.445	2,912	40
Delta IV Medium w/ 4 solids	0.05	VAFB1	VAFB	5.1	556	1.087	324	4
	0.05	VAFB2	VAFB	7.7	2,551	0.672	1,257	17
	0.05	VAFB3	VAFB	4.5	2,830	0.404	1,382	19
	0.1	VAFB1	VAFB	5.1	831	1.213	484	7
	0.1	VAFB2	VAFB	7.7	3,786	0.801	1,867	26
	0.1	VAFB3	VAFB	4.5	4,230	0.531	2,063	28

Because of the methodology used, the REEDM rain washout results should be indicative of an upper bound of the amount of hydrogen chloride that could be deposited. As shown in Appendix T, REEDM results were calculated for 1-kilometer intervals from 1 to 40 kilometers. The REEDM rain washout results at each of these locations is independent of all other calculations. The calculation at each point assumes that rain occurs only when the stabilized ground cloud is above the point for which the calculations are being made. So, for example, the REEDM rain washout value at a distance of 4 kilometers assume no rain fell until the cloud reached a distance of 4 kilometers, and, similarly, the value at a distance of 5 kilometers assume no rain fell until the cloud reached a distance of 5 kilometers. Because of this approach, it is expected that the REEDM results represent an upper bound on the amounts of hydrogen chloride that could be deposited by rain washout at distances beginning at 1,000 to 3,000 meters downwind from the launch sites.

Monitoring of launches of Delta, Atlas, and Titan at CCAFS (Schmalzer, et al., 1998) provides an indication of possible deposition of acid and aluminum oxide in the immediate vicinity of the launch sites. If the near-ground exhaust cloud contained excess moisture, or if rain fell through the cloud, acid and aluminum oxide were deposited near the launch sites. The pH of deposited acid could be as low as one or less. Quantities of acid deposited were not determined by Schmalzer, et al. (1998), but for larger vehicles (Titan IV and the Space Shuttle), acid deposition has at times been sufficient to cause fish kills in nearby waters because of temporary reductions in pH. It was noted that acid deposition decreased with distance , but some occurrences of deposition at distance (as indicated by the REEDM results). For the Atlas IIAS, most of the deposition is likely to occur near the launch facility ("within several hundred feet"). During fourteen launches of Delta II acid deposition occurred at least once over an area of 70,807 square meters, with a maximum distance of 648 meters from the launch pad. Deposition of acid during 20 launches of Atlas IIAS did not cause acid deposition.

Maximum amounts of acid produced per launch by the vehicles evaluated in this report are similar to or slightly greater than the maximum amounts evaluated by Schmalzer, et al. (1998). Therefore acid deposition is expected to be similar to, or somewhat greater than that evaluated by them.

Light rains after launches can scavenge Al_2O_3 and HCl from the propellant exhaust cloud. These would be rare events because of the combination of meteorological conditions required. Depending on vehicle and launch location, deposition modeling using REEDM (summarized above in Table R-1) indicates a maximum of 14,094 milligram per square meter of HCl for nominal launches and a maximum of 3,444 milligram per square meter of HCl for launch failures that would be deposited as droplets up to 1,000 to 4,000 meters from the launch site. That amount of HCl for nominal launches equates to 386.55 milliequivalents of hydrogen ion and for launch failures it equates to 94.46 milliequivalents of hydrogen ion. As a hypothetical example, if those amounts of acid were deposited on an unbuffered water body with a depth of 10 centimeters (about 4 inches), there would be 100 liters of water per square meter, and the acid concentrations for nominal launches would be 3.86 milliequivalents per liter and for launch failures would be 0.94 milliequivalents per liter. Without buffering, the resultant pH for nominal launches would be 2.68 and for launch failures would be 3.03. Because approximately 50 milligrams of $CaCO_3$ would be required to neutralize each milliequivalent of acid, the deposition of 14,094 milligrams of HCl per square meter for

nominal launches and 3,444 milligrams of HCl per square meter for launch failures would consume a total alkalinity of approximately 193 milligram per liter for nominal launches and 47 milligram per liter for launch failures in this example. The deposition modeling indicates that the amount of acid deposited decreases exponentially downwind from the point of maximum deposition, with an initial reduction of about one-half approximately 4,000 meters downwind from the area of maximum deposition. Surface waters at both CCAFS and Vandenberg AFB have ample alkalinity to neutralize the maximum acid deposition, but short-term reductions in pH could occur.

Background Water Quality Data

The tables in this appendix describe acid deposition runs and surface water quality monitoring data from waters near launch facilities at Vandenberg AFB. The information in Table R-2 supports the analysis of the potential for acid deposition at Vandenberg AFB, presented in the Water Quality section of this document (Section 4.9).

TABLE R-2
Surface Water Quality Monitoring Data from Waters Near Launch Facilities at Vandenberg AFB, California

Location/Date	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	Acid	pH	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/ L)	Sodium (mg/ L)
Santa Ynez Creek								
3/1/94	540	253	<1	7.5	120	94	59	95
9/1/94	754[a]	789	49	7.9	170	789	80	140
5/1/95	880	252	15	7.4	170	120	110	120
9/1/95	410	394	9	7.6	116	144	56.6	128
Cañada Honda Creek								
3/1/94	603	309	<1	8.1	110	180	60	150
6/1/94	603	349	<1	7.8	116	250	76	180
9/1/94	749[a]	0[b]	<1	8.7	150	240	91	210
12/1/94[c]	3720[a]	240	26	8.4	324	12,000	707	5,230
3/1/95	620	240	11	7.6	120	160	78	100
6/1/95	430[a]	350	<1	7.2	103	250	42	331
9/1/95	1069	352	<1	7.3	166	<1	159	1103
12/1/95[c]	2805[a]	250	<1		251	<1	529	3,771
4/1/96	456[a]	350	<2		87	350	58	170
6/1/96		340	<5			240	70	170
12/1/96		264	<1			1,840	211	1,204
Bear Creek								
3/1/94	440	251	6	0.7[d]	85	360	55	200
9/1/94	351[a]			8.6	70	330	43	180
3/1/95	340			7.9	65	220	44	130
9/1/95	449	332	<1	7.2	86		56	175
Spring Canyon								
3/1/95	150			7.7	25	130	21	130

Appendix S
Clean Air Act Conformity Applicability Analysis for Vandenberg AFB

Purpose

The U.S. Air Force is required to perform a formal air conformity applicability analysis to determine whether the Evolved Expendable Launch Vehicle (EELV) program at Vandenberg Air Force Base (AFB), California, complies with the U.S. Environmental Protection Agency (EPA) Final Conformity Rule, 40 Code of Federal Regulations (CFR) 93, Subpart B (for federal agencies) and 40 CFR 51, Subpart W (for state requirements) of the amended Clean Air Act (CAA).

Background

The U.S. EPA has issued regulations clarifying the applicability of and procedures for ensuring that federal activities comply with the amended CAA. The EPA Final Conformity Rule implements Section 176(c) of the CAA, as amended in 42 U.S. Code (USC) 7506(c). This rule was published in the *Federal Register* on November 30, 1993, and took effect on January 31, 1994.

The EPA Final Conformity Rule requires all federal agencies to ensure that any federal action resulting in nonattainment criteria pollutant emissions conforms with an approved or promulgated state implementation plan (SIP) or federal implementation plan (FIP). Conformity means compliance with a SIP/FIP's purpose of attaining or maintaining the National Ambient Air Quality Standards (NAAQS). Specifically, this means ensuring that the federal action will not: (1) cause a new violation of the NAAQS; (2) contribute to any increase in the frequency or severity of violations of existing NAAQS; or (3) delay the timely attainment of any NAAQS interim milestones, or other attainment milestones. NAAQS are established for six criteria pollutants: ozone (O_3), carbon monoxide (CO), particulate matter equal to or less than 10 microns in diameter (PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). The current standards apply to federal actions in NAAQS nonattainment or maintenance areas only.

Status

The proposed EELV program would be implemented at Vandenberg AFB in Santa Barbara County, California. The original EELV program was found to be exempt from general conformity requirements in a conformity applicability analysis provided with the 1998 FEIS. General conformity for the entire EELV program is being re-addressed in this analysis due to proposed changes in some aspects of the EELV program as presented in the FSEIS.

Air quality management in Santa Barbara County is under the jurisdiction of the Santa Barbara County Air Pollution Control District (SBCAPCD), the California Air Resources Board (CARB),

and EPA Region 9. All sections of SBCAPCD's Rule 702 were adopted verbatim from the federal General Conformity regulation (58 Federal Regulation [FR] 63214, November 30, 1993), except for provision 51.860, preambled below.

51.860 Mitigation of Air Quality Impact

(A) Any measures that are intended to mitigate air quality impact must be identified (including the identification and quantification of all emission reductions claimed) and the process for implementation (including any necessary funding of such measures and tracking of such emission reductions) and enforcement of such measures must be described, including an implementation schedule counting explicit timelines for implementation.

(B) Prior to determining that a federal action is in conformity, the federal agency making the conformity determination must obtain written commitments from the appropriate persons or agencies to implement any mitigation measures that are identified as conditions for making conformity determinations. Such written commitments shall describe such mitigation measures and the nature of the commitment, in a manner consistent with paragraph (A).

(C) Persons or agencies voluntarily committing to mitigation measures to facilitate positive conformity determinations must comply with the obligations of such commitments.

(D) In instances where the federal agency is licensing, permitting or otherwise approving the action of another governmental or private entity, approval by the federal agency must be conditioned on the other entity meeting the mitigation measures set forth in the conformity determination, as provided in paragraph (A).

(E) When necessary because of changed circumstances, mitigation measures may be modified so long as the new mitigation measures continue to support the conformity determination in accordance with 51.858 and 51.859 and this section. Any proposed change in the mitigation measures is subject to the reporting requirements of Section 51.856, and the public participation requirements of Section 51.857.

(F) After a state revises its SIP to adopt its general conformity rules and EPA approves that SIP revision, any agreements, including mitigation measures, necessary for a conformity determination will be both state and federally enforceable. Enforceability through the applicable SIP will apply to all persons who agree to mitigate direct and indirect emissions associated with a Federal Action for a conformity determination. Adopted 10/20/94.

Other than the above listed, Santa Barbara County is following federal implementation guidelines.

The area of Santa Barbara County containing Vandenberg AFB complies with state and federal standards for SO_2, NO_2, CO, and lead. The entire Santa Barbara County is classified as in serious nonattainment for ozone. The classification of nonattainment for PM_{10} is by state standards only. The SBCAPCD did not meet its emission goals for moderate nonattainment for ozone. As a result, the district was reclassified to ozone **serious** nonattainment in December 1997.

The EPA Final Conformity Rule requires that total direct and indirect emissions of nonattainment criteria pollutants, including ozone precursors (volatile organic compounds

[VOCs] and nitrogen oxides [NO_x]), be considered in determining conformity. The rule does not apply to actions where the total direct and indirect emission of nonattainment criteria pollutants do not exceed threshold levels for criteria pollutants established in 40 CFR 93.135(b). Table S-1 presents the de minimis threshold level of nonattainment areas. This analysis compares air emissions totals to both de minimis thresholds to take into consideration the ozone reclassification status of Santa Barbara County from moderate to serious nonattainment.

TABLE S-1
De Minimis Threshold in Nonattainment Areas (tons per year)

Pollutant	Degree of Nonattainment Level	De Minimis[a, b]
Ozone (VOCs and NO_x)	Moderate	100
	Serious	**50**
	Severe	25
	Extreme	10
VOCs	Marginal	50
NO_x	Marginal	100
Carbon Monoxide	All	100
Particulate Matter	Moderate	100
	Serious	70
SO_2 or NO_2	All	100
Lead	All	25

[a]The de minimis threshold level for ozone in Santa Barbara County was reclassified to 50 tons per year.
[b]The number in bold reflects de minimis threshold used in this analysis.
NO_2 = nitrogen dioxide.
NO_x = nitrogen oxides.
SO_2 = sulfur dioxide.
VOCs = volatile organic compound.
Source: Santa Barbara County Air Pollution Control District - Regulation VII, Rule 702

In addition to meeting de minimis requirements, a federal action must not be considered a regionally significant action. A federal action is considered regionally significant when the total emissions from the action equal or exceed 10 percent of the air quality control area's emission inventory for any criteria pollutant. If a federal action meets de minimis requirements and is not considered a regionally significant action, then it is exempt from further conformity analyses pursuant to 40 CFR 93.153(c).

Summary of Air Pollutant Emissions and Regulatory Standards

This section provides a summary of the Santa Barbara County noncompliance pollutant standards, as defined in the 1998 Clean Air Plan for Santa Barbara County (Santa Barbara County, 1998).

As discussed in the air quality sections of both the environmental impact statement (EIS) and the Supplemental EIS (SEIS) for the EELV program, Santa Barbara County is currently in violation of the state PM_{10} standard and the state and federal ozone standards. Exceedances of the annual state standard for PM_{10} have occurred only at the downtown Santa Maria monitoring station, while the 24-hour PM_{10} state standard (50 $\mu g/m^3$ for California and 150 $\mu g/m^3$ for the federal standard) violations are dispersed throughout the county. Because Vandenberg AFB is located in Santa Barbara County, which does not exceed federal PM_{10} standards and is unclassified by federal standards, a PM_{10} analysis is not included as part of this Air Conformity Applicability Analysis.

Both the federal CAA and the California State CAA set up a method for classifying areas according to severity of ozone. These classifications determine regulatory requirements and target dates for ozone standard attainment. Five classifications have been mandated for ozone: marginal, moderate, serious, severe, and extreme. The current federal ozone standard is 0.12 parts per million. An area is designated as being in nonattainment if it violates the standard more than three times in 3 years at a single monitoring station. As mentioned in the EIS, the EPA has approved a new ozone standard. The new standard and implementation measures have not yet been approved in the Santa Barbara County Air Quality Management Plan or SIP.

For federal actions, an air conformity applicability analysis and (if needed) a conformity determination are required when the total of direct and indirect emissions of a criteria pollutant in a nonattainment or maintenance area caused by the federal action equals or exceeds the de minimis thresholds. The nonattainment pollutants included in this analysis are the ozone precursors (measured by VOCs and NO_x).

Emission Modeling

A total of direct and indirect emissions (increases and decreases) from the EELV program concepts was estimated using methods similar to those presented in the FEIS and FSEIS. The following conformity-related emission sources were considered in the emission estimates: launch emissions, operational direct and indirect emissions, construction-related emissions, and mobile source (direct and indirect) emissions from operations. The emissions estimates for this project were calculated for the following years: construction years 2000, 2001, and 2002; EELV operation years 2001 and 2002 and beyond; Air Quality Management Plan Conformity Growth year 2006; and expected peak launch year 2007. The year 2014 is also presented for consistency with the Air Conformity Applicability Analysis done for the 1998 FEIS. For comparison with the 1998 FEIS it should be noted that EELV construction is no longer scheduled to occur during the years 1998 and 1999. The baseline year is 1995, which is the most recent year for which detailed emissions information was available at the time of the analysis. Emissions were totaled for sources associated with the EELV program; unrelated activities that occur at Vandenberg AFB were not included in the comparison.

Indirect emissions are defined in 40 CFR 93.152 as emissions of a criteria pollutant which: (1) are caused by a federal action, but may occur later in time and/or may be farther removed in distance from the action itself, but are still reasonably foreseeable, and (2) the federal agency can practicably control and will maintain control over because of a continuing program responsibility.

The air quality modeling analysis required under the conformity rule must be based on the applicable air quality model, databases, and other requirements specified in the "Guideline on Air Quality Models (Revised)" (1986), including supplements (EPA Publication No. 450/2-78-027R) and the *Air Force Conformity Guide Handbook.* Models used in this applicability analysis to determine air emissions resulting from the EELV program at Vandenberg AFB include the EMFAC 7G module of the California Air Resources Board's Motor Vehicle Emission Inventory Model (California Environmental Protection Agency, 1996), the state of California-approved model for motor vehicles, and emission factors of aircraft associated with EELV component deliveries from *Emissions and Dispersion Modeling System* (EDMS, Version 3.0). Emissions of VOCs and NO_x generated by facility construction activities were projected based on CEQA Air Quality Handbook (South Coast Air Quality Management District, 1993) and AP-42 (U.S. Environmental Protection Agency, 1995) factors. These emission factors have been established for each of the following categories of construction activity:

- Grading Equipment: Emissions in the grading phase are primarily associated with the exhaust from large earth-moving equipment.
- Asphalt Paving: VOC emissions in the asphalt paving phase are released through the evaporation of solvents contained in paving materials.
- Stationary Equipment: Emissions from stationary equipment occur when machinery such as generators, air compressors, welding machines, and other similar equipment are used at the construction site.
- Mobile Equipment: Mobile equipment includes forklifts, dump trucks, excavators, etc.
- Architectural Coatings: VOCs are released through the evaporation of solvents that are contained in paints, varnishes, primers, and other surface coatings.
- Commuter Automobiles: Commuter traffic emissions are generated from commuter trips to and from the work site by construction employees. The average vehicle ridership number (1.5 persons per vehicle) from the California Environmental Quality Act (CEQA) Handbook was applied.

For the purpose of comparison, it should be noted that the Air Conformity Applicability Analysis in the 1998 FEIS used the previous version of EMFAC, version 7F; whereas, as noted above, version 7G has been used here. As noted in its release letter (California Air Resources Board, 1996), for years 2000 and beyond, EMFAC7G will predict lower levels of ROG than did EMFAC7F. This is because EMFAC7G takes into account the effects of the state-mandated use of low-emission vehicles while EMFAC7F did not.

Construction and operational requirements and associated emissions for both the Atlas V and Delta IV programs were re-assessed for this analysis. Construction equipment–and its associated emissions–are accounted for and details are described in Tables S-3 through S-9. The construction schedule for Delta IV facilities was compressed from four years to three and moved from 1998-2001 to 2000-2002. The Atlas V facilities construction schedule remained essentially unchanged. In addition, Delta IV facilities construction analyzed in this analysis expanded slightly to include modifications to the South Vandenberg Boat Dock, dredging, and construction of an open parking area near the dock (see Table S-7).

Both Boeing and Lockheed Martin Corporation (LMC) have revised their estimates of operational staffing from the figures provided in the 1998 FEIS. In particular, estimates of day-to-day staffing, which is present whether or not a launch is occurring, has changed. These changes are presented in Table S-2.

TABLE S-2
Comparison of FEIS and Current Estimated Day-to-Day Staffing

YEAR(S)	FEIS (1998)		Current	
	LMC	Boeing	LMC	Boeing
2001	115	340	0	100
2002	125	370	200	134
2003	128	400	200	167
2004	130	400	200	200
2005	133	400	200	234
2006	135	400	200	267
2007-2020	135	400	200	300

The reduction in the total day-to-day staffing (especially in the early years of the program) resulted in a reduction in both VOCs and NOx from this source. In addition to the day-to-day staffing, emissions calculated on a per launch basis (increased staff, deliveries, maintenance activities, launch vehicle emissions, etc.) also decreased in the early years of the program due to reductions in scheduled launches from four and six in 2001 and 2002 as projected in the FEIS to zero and two, respectively, as currently projected in the FSEIS.

Tables and Emission Data

Emission calculations for VOCs were performed as consistently as possible. Several information sources identify "ROC," for reactive organic compounds, instead of "VOC," for volatile organic compounds. For all practical purposes, these two terms can be considered equivalent. The federal government generally uses the term VOC, which is defined, in part, in 40 CFR 60.2, as "any organic compound which participates in atmospheric photochemical reactions." The term VOC has been chosen for use in this document. When using emission factors that list emissions as "total hydrocarbons" and "total non-methane hydrocarbons," the document uses "total non-methane hydrocarbons" as a VOC equivalent. Methane does not participate in atmospheric photochemical reactions and therefore does not fall under the definition of VOC. While there are other hydrocarbons that similarly do not fall under the definition of VOC, the use of "total non-methane hydrocarbons" as a VOC equivalent is considered conservative and appropriate.

The emissions of ozone precursors (VOCs and NO_x) and other criteria pollutants that would result from construction and implementation of the EELV program are shown in Tables S-3 and S-4.

TABLE S-3
Comparison of EELV Annual Emission Inventory at Vandenberg AFB (tons/year)

Pollutant	Emission Sources	2000	2001	2002	2006	2007	2014
VOCs	Construction-Related						
	Grading Equipment and Asphalt Paving	1.3	3.7	0.0			
	Stationary Equipment	7.1	7.1	0.7			
	Mobile Equipment	3.7	7.2	0.2			
	Subtotal for Construction Equipment[(a)(b)]	12.1	17.9	0.9			
	Architectural Coatings						
	(Non-Residential)	1.8	11.0	3.6			
	Commuter Automobile	2.2	1.9	0.3			
	Total Construction-Related Emissions	16.1	30.8	4.8			
	Operation-Related						
	Program Launches		0.0	0.0	0.0	0.0	0.0
	Preparation and Assembly		0.0	1.4	4.2	7.0	5.0
	Mobile Sources[(c)]		1.1	3.3	3.5	3.6	2.1
	Point Sources		0.8	0.8	0.8	0.8	0.8
	Total Operation-Related Emissions		1.9	5.5	8.6	11.5	8.0
	Emission Decreases from FEIS No-Action		(1.5)	(2.7)	(4.1)	(4.8)	(5.1)
	Total Project Emissions	**16.1**	**31.2**	**7.7**	**4.5**	**6.7**	**2.9**
NOx	Construction-Related						
	Grading Equipment and Asphalt Paving	11.8	7.6	0.5			
	Stationary Equipment	2.3	3.1	0.0			
	Mobile Equipment	22.2	25.6	1.2			
	Subtotal for Construction Equipment[(a)(b)]	36.4	36.3	1.8			
	Architectural Coatings						
	(Non-Residential)	0.0	0.0	0.0			
	Commuter Automobile	3.9	3.2	0.6			
	Total Construction Emissions	40.3	39.5	2.4			
	Operation-Related						
	Program Launches		0.0	1.9	5.6	8.9	6.0
	Preparation and Assembly		0.0	0.0	0.0	0.0	0.0
	Mobile Sources[(c)]		2.7	8.2	8.9	9.6	6.5
	Point Sources		8.7	8.7	8.7	8.7	8.7
	Total Operation-Related Emissions		11.4	18.8	23.2	27.2	21.2
	Emission Decreases from FEIS No Action		(9.8)	(10.5)	(10.9)	(11.6)	(11.3)
	Total Project Emissions	**40.3**	**41.1**	**10.7**	**12.3**	**15.6**	**9.9**

[a]Details of Construction Equipment are shown in Tables S-5 and S-6. Construction Equipment added due to additional Boeing construction is shown in Table S-7.
[b]Emission Factors used for Construction Equipment are shown in Tables S-8 and S-9.
[c]Details of Operation-Related Mobile Sources are shown in Table S-10.

NO_x = nitrogen oxides
VOC = volatile organic compound

TABLE S-4
Comparison of Pollutant Emissions to Emissions Inventory

		Emissions (tons/year)			
Proposed Action	**Year**	**VOCs**	**% of Inventory**	**NOx**	**% of Inventory**
Santa Barbara County Emissions Inventory [a]		44,460		16,589	
	2000	16.1	0.04	40.3	0.24
	2001	31.2	0.07	41.1	0.25
	2002	7.7	0.02	10.7	0.06
	2006	4.5	0.01	12.3	0.07
	2007	6.7	0.02	15.6	0.09
	2014	2.9	0.01	9.9	0.06

(a)1996 Santa Barbara County Planning Emission Inventory (Santa Barbara County, 1998).
NO_x = nitrogen oxides.
VOCs = volatile organic compounds.

Analysis

The total of direct and indirect emissions resulting from EELV construction and operational activities is illustrated in Table S-3. The VOC and NOx emissions were estimated based on construction and program information provided by each of the two contractors and revised launch rates provided by the Air Force. Emissions fall below the de minimis threshold of 50 tons for conformity. A formal air conformity determination will not be required for the EELV program, as required by the CAA, 40 CFR Part 93. The analysis for conformity will be in effect for 5 years unless the action changes. Total emissions from the EELV program are less than 10 percent of the Santa Barbara County emission inventory; therefore, the EELV program is not regionally significant.

Changes between Table K-4 in the FEIS and Table S-3 in this Appendix were driven by four primary factors: (1) differences in modeling results due to differences between EMFAC versions 7F (used in the FEIS) and 7G (used in this analysis), (2) changes in operational day to day staffing for Boeing and LMC, especially in the early years of the program, (3) a substantial reduction in launch rates in 2001 and 2002 and (4) a compression and shift of Boeing's construction schedule. Factors one, two, and three tended to reduce VOCs and NOx emitted during the 2000-2002 period while factor four tended to increase the VOC and NOx emissions during the same period. The end result moved the year with the highest NOx levels from 2000 to 2001 and lowered the highest predicted level from 46.4 tons to 41.1 tons.

Several elements of the data presented in Table S-3 are provided in greater detail in the following tables:

- Details of the construction equipment presented in Table S-3 are shown in Tables S-5 and S-6.
- Additional Boeing construction equipment tasks not addressed in the original conformity applicability analysis (boat dock modification, CBC staging area) are shown in Table S-7.
- Emission factors used for construction equipment are shown in Tables S-8 and S-9.
- Details of Operation-Related Mobile Sources are shown in Table S-10.

TABLE S-5

Monthly Operating Hours for Construction Equipment at Vandenberg AFB for LMC (Part 1 of 2)

Equipment Type	Jan '00		Feb '00		Mar '00		Apr '00		May '00		Jun '00		Jul '00		Aug '00		Sep '00		Oct '00		Nov '00		Dec '00	
	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours
Pickup Trucks (3/4 ton)	13	1560	13	1560	13	1560	28	3360	28	3360	28	3360	33	3960	32	3840	32	3840	32	3840	29	3480	29	3480
Flat Bed Truck							3	288	3	288	3	288	3	288	3	288	3	288	3	288				
Transportation Vehicles (Vans)	6	432	6	432	6	432	10	720	10	720	10	720	10	720	10	720	10	720	10	720	10	720	10	720
Semi-Trucks							6	576	6	576	6	576	6	576	6	576	6	576	6	576	6	576	6	576
Crawler Crane																			1	192	1	192	1	192
Backhoe-1-1/2 cy Bucket			2	288	2	288	2	288	2	288	2	288												
Backhoe w/Demolition Attachment							2	384	2	384	2	384	2	384	2	384	2	384	2	384	2	384	2	384
Crane -15T to 35T Capacity									3	288	3	288	3	288	3	288	3	288	3	288	3	288	3	288
Dozer							2	332	2	200	2	80	2	72							2	152	2	72
Scraper/Pan							3	498	3	528	3	294	3	294										
Motor Grader									1	176	1	176	1	176	1	176	1	176	1	176	1	176		
Plate Compactor									1	176	1	176	1	176	1	176	1	176	1	176	1	176		
Front End Loader							1	88	1	176	1	176	1	176	1	176	1	176	1	176	1	176		
Roller									1	88	1	88	1	88	1	88	1	88	1	88	1	88		
Water Truck							1	88	1	88	1	88	1	88	1	88	1	88	1	88	1	88	1	88
Paving Machine																								
Skip Loader							1	176	1	176	1	176	1	176	1	176	1	176	1	176	1	176	1	176
Service Truck							1	22	1	22	1	22	1	22	1	22	1	22	1	22	1	22	1	22
Bucket Truck																								
Line Truck																			1	96	1	96	1	96
Trencher																	1	120	1	120	1	120	1	120
Manlift																					2	240	2	240
750-cfm Air Compressor															2	336	2	336	2	336	2	336	2	336
375-cfm Air Compressor							1	144	1	144	1	144	1	144	1	144	1	144	1	144	1	144	1	144
300-amp Welding Machine																					6	864	6	864
600-amp Welding Machine													12	1728	12	1728	12	1728	12	1728	16	2304	16	2304
600-amp Shear Stud Welder																					1	144	1	144
Forklift									2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240

TABLE S-5
Monthly Operating Hours for Construction Equipment at Vandenberg AFB for LMC (Part 2 of 2)

Equipment Type	Jan '01		Feb '01		Mar '01		Apr '01		May '01		Jun '01		Jul '01		Aug '01		Sep '01		Oct '01		Nov '01		Dec '01		Jan '02	
	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours
Pickup Trucks (3/4 ton)	31	3720	33	3960	33	3960	33	3960	33	3960	33	3960	29	3480	29	3480	25	3000	25	3000	19	2280	19	2280	9	1080
Flat Bed Truck																										
Transportation Vehicles (Vans)	10	720	10	720	10	720	10	720	10	720	10	720	10	720	10	720	10	720	6	432	6	432	6	432		
Semi-Trucks	6	576	6	576	6	576	6	576	6	576	6	576														
Crawler Crane	1	192	1	192	1	192	1	192	1	192																
Backhoe-1-1/2 cy Bucket																										
Backhoe w/Demolition Attachment																										
Crane -15T to 35T Capacity	3	288	3	288	2	192	2	192	2	192	1	96	1	96	1	96	1	96	1	96	1	96	1	96		
Dozer																										
Scraper/Pan																										
Motor Grader					1	176	1	88	1	88	1	88														
Plate Compactor					1	176	1	176	1	176	1	88														
Front End Loader					1	176	1	176	1	176																
Roller							1	44	1	44																
Water Truck	1	88	1	88	1	88	1	88	1	88	1	88	1	88												
Paving Machine											1	44	1	44	1	44	1	44	1	88	1	88	1	44		
Skip Loader	1	176	1	176	1	176	1	176	1	176	1	176	1	176												
Service Truck	1	22	1	22	1	22	1	22	1	22	1	22	1	22												
Bucket Truck																										
Line Truck	1	96	1	96	1	96	1	96																		
Trencher	1	120	1	120	1	120	1	120	1	120	1	120	1	120	1	120	1	120	1	120	1	120				
Manlift	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240		
750-cfm Air Compressor	2	336	2	336	2	336																				
375-cfm Air Compressor	2	288	2	288	2	288	2	288	2	288	2	288	2	288	2	288										
300-amp Welding Machine	6	864	6	864	6	864	6	864	6	864	6	864														
600-amp Welding Machine	16	2304	16	2304	16	2304	16	2304	16	2304	2	288	2	288	2	288	2	288	2	288						
600-amp Shear Stud Welder	1	144	1	144	1	144	1	144	1	144	1	144														
Forklift	2	240	2	240	2	240	2	240	2	240	2	240	2	240	2	240	1	120	1	120	1	120	1	120		

TABLE S-6
Monthly Operating Hours for Construction Equipment at Vandenberg AFB for Boeing (Part 1 of 3)

Equipment Type	Feb '00		Mar '00		Apr '00		May '00		Jun '00		Jul '00		Aug '00		Sep '00		Oct '00		Nov '00		Dec '00	
	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours
Trencher (Diesel)	1	134	1	134	1	67	1	134					1	24								
Backhoe (Diesel)	1	67	1	67	1	67	1	134					1	48								
D-B Bull Dozer (Diesel)	1	125	1	125	1	125	1	125							1	40						
977 Front End Loader (Diesel)	1	116	1	116	1	116	2	232	2	232												
12CY Dump Truck (Diesel)	3	174	2	232	3	349	6	697	2	232	2	232										
Plate Compactor (Gas)	1	125	1	125	1	125															2	80
Sheeps Foot (Diesel)			1	63	1	63	1	125									1	80				
Motor Grader CAT 12G (Diesel)															1	40	1	125	1	125	1	125
Excavator CAT 235 (Diesel)	1	125	1	125	2	250	2	250	2	250	1	125										
Welding Machines (Gas)	4	533	4	533	4	533	10	1333	10	1333	10	1333	10		10	1333	10	1333	8	1066	8	1066
125-Ton Crane (Diesel)	1	125	1	125	1	125	2	250	2	250	2	250	2		2	250	2	250	1	125	1	125
230-Ton Crane (Diesel)					1	63	1	125	1	125	1	125	1		1	125	1	125	1	125	1	125
45-Ton Cherry Picker (Diesel)	2	250	2	250	3	375	6	750	6	750	6	750	4		4	500	4	500	4	500	4	500
5-Ton Fork Lift (Gas)	1	115	1	115	1	115	2	230	2	230	2	230	2		2	230	2	230	2	230	2	230
80-Ft Man Lift (Gas)	1	95	1	95	1	95	2	190	2	190	2	190	2		2	190	2	190	2	190	2	190
Flat Bed Truck (Diesel)	2	189	2	189	2	189	4	378	4	378	4	378	4		4	378	4	378	4	378	4	378
Cars, Pick-ups (Gas)	7	543	7	543	7	543	14	1085	14	1085	14	1085	14		14	1085	12	930	12	930	8	620
Asphalt Paver (Diesel)					1	63	1	125											1	40	1	40
Water Truck (Diesel)			1	134	1	134	1	134									1	80				
Air Compressor (Gas)			1	125	2	250	4	500	4	500	2	250	2	250	2	250	2	250	2	250	1	125
Semi-Truck Deliveries (General)	200	400	200	400	200	400	160	320	160	320	160	320	200	400	200	400	201	408	201	408	201	408
Concrete Trucks							160	320	160	320	160	320	40	80	40	80	40	80	40	80	40	80
Semi-Truck Deliveries (Steel)	100	200	100	200	100	200	80	160	80	160	80	160	120	240	120	240	120	240	120	240	120	240
500-HP Dredge (Diesel)																						
750-HP Tugboats (Diesel)																						

TABLE S-6
Monthly Operating Hours for Construction Equipment at Vandenberg AFB for Boeing (Part 2 of 3)

Equipment Type	Jan '01		Feb '01		Mar '01		Apr '01		May '01		Jun '01		Jul '01		Aug '01		Sep '01		Oct '01		Nov '01		Dec '01	
	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours
Trencher (Diesel)							2	267	2	267	2	267	2	267	2	267	2	267	2	267	2	267	1	133
Backhoe (Diesel)							1	133	2	397	1	133	2	267	2	267	2	267	2	267	2	267	1	67
D-B Bull Dozer (Diesel)	1	125	2	250	2	250	1	125	2	257													1	125
977 Front End Loader (Diesel)	1	116	1	116	2	232	2	232	2	232	2	232	1	116	1	116	1	116	2	232	2	232	1	116
12CY Dump Truck (Diesel)	2	232	2	232	2	232	4	464	6	728	4	464	2	232	2	232	1	116	1	116	1	116	3	174
Plate Compactor (Gas)					1	125	2	250	2	250	2	250	2	250	1	125	1	125	1	125	1	125		
Sheeps Foot (Diesel)			2	250	2	250	2	250	2	250	2	250	2	250	1	125	1	125						
Motor Grader CAT 12G (Diesel)			1	125	1	125	1	125	1	125	1	125	1	125	1	125	1	125	1	125	1	125		
Excavator CAT 235 (Diesel)	2	250	2	250	2	250	2	250	2	250	2	250	2	250	2	250	1	125	1	125				
Welding Machines (Gas)	4	533	4	533	6	800	2	267	4	533	4	533	4	533	4	533	4	453	4	453	4	453	4	533
125-Ton Crane (Diesel)	1	125	1	125	1	125					1	125	2	250	2	250	2	250	1	250	1	250	1	125
230-Ton Crane (Diesel)	1	125																						
45-Ton Cherry Picker (Diesel)	4	500	2	250	3	375	2	250	3	380	3	380	4	500	4	500	4	500	2	250	2	250	2	250
5-Ton Fork Lift (Gas)	2	230	1	115	1	115	2	230	2	230	2	230	2	230	2	230	2	230	2	230	2	230	1	115
80-Ft Man Lift (Gas)	2	190													2	190	2	190	2	190	2	190	1	95
Flat Bed Truck (Diesel)	4	378	2	190	3	285	1	95	2	190	2	190	4	378	4	378	4	378	4	378	4	378	2	189
Cars, Pick-ups (Gas)	12	930	12	930	12	930	6	465	6	465	6	465	8	620	8	620	10	775	10	775	12	930	7	542
Asphalt Paver (Diesel)	1	125	1	125																				
Water Truck (Diesel)					1	134	1	134											1	134	1	134		
Air Compressor (Gas)	1	125							1	125	1	125	1	125	1	125	1	125						
Semi-Truck Deliveries (General)	260	520	260	520	300	600	140	280	140	280	120	240	120	240	120	240	120	240	120	240	120	240		
Concrete Trucks	1	16			160	320	160	320	160	320	80	160	80	160	80	160	80	160	80	160	80	160		
Semi-Truck Deliveries (Steel)	120	240	120	240	160	320	80	160	80	160	60	120	60	120	60	120	60	120	60	120	60	120		
500-HP Dredge (Diesel)							1	264	1	264														
750-HP Tugboats (Diesel)							1	180	1	20														

TABLE S-6
Monthly Operating Hours for Construction Equipment at Vandenberg AFB for Boeing (Part 3 of 3)

Equipment Type	Jan '02		Feb '02	
	No	Hours	No	Hours
Trencher (Diesel)	1	133	1	67
Backhoe (Diesel)	1	67	1	67
D-B Bull Dozer (Diesel)	1	125	1	125
977 Front End Loader (Diesel)	1	116	1	116
12CY Dump Truck (Diesel)	2	232	3	348
Plate Compactor (Gas)				
Sheeps Foot (Diesel)	1	62	1	62
Motor Grader CAT 12G (Diesel)				
Excavator CAT 235 (Diesel)				
Welding Machines (Gas)	4	533	4	533
125-Ton Crane (Diesel)	1	125	1	125
230-Ton Crane (Diesel)			1	62
45-Ton Cherry Picker (Diesel)	2	250	3	375
5-Ton Fork Lift (Gas)	1	115	1	115
80-Ft Man Lift (Gas)	1	95	1	95
Flat Bed Truck (Diesel)	2	189	2	189
Cars, Pick-ups (Gas)	7	542	7	542
Asphalt Paver (Diesel)			1	62
Water Truck (Diesel)				
Air Compressor (Gas)	1	125	2	250
Semi-Truck Deliveries (General)				
Concrete Trucks				
Semi-Truck Deliveries (Steel)				
500-HP Dredge (Diesel)				
750-HP Tugboats (Diesel)				

TABLE S-7
Monthly Operating Hours for Additional Construction Equipment at Vandenberg AFB for Boeing Construction Not Addressed in Original 1998 Conformity Applicability Analysis (Subset of Construction Equipment shown in Table S-6)

Equipment Type	Aug '00		Sept '00		Oct '00		Nov '00		Dec '00		Jan '01		Feb '01		Mar '01		Apr '01		May '01	
	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours	No.	Hours
Trencher (Diesel)	1	24																		
Backhoe (Diesel)	1	48																	1	264
D-8 Bull Dozer (Diesel)			1	40															1	132
12CY Dump Truck (Diesel)																			2	264
Plate Compactor (Gas)									2	80										
Sheeps Foot (Diesel)					1	80														
Motor Grader CAT 12G (Diesel)			1	40																
500-HP Dredge (Diesel)																	1	264	1	264
750-HP Tugboats (Diesel)																	1	180	1	20
Asphalt Paver							1	40	1	40										
Water Truck (Diesel)					1	80														
Concrete Trucks											1	16								
Semi-Truck Deliveries					1	8	1	8	1	8										

TABLE S-8
Emissions Factors for LMC Construction Equipment

Equipment Type	Emission Factors for Criteria Pollutants (lbs/hr and lbs/hp-hr)		Reference (a)	Equipment Class
	ROC	NOx		
Pickup Trucks (3/4 ton)	0.09287	0.4648	AP-42	HDDV @ 1995 Fleet, <4000ft
Flat Bed Truck	0.09287	0.4648	AP-42	HDDV @ 1995 Fleet, <4000ft
Transportation Vehicles (Vans)	0.09287	0.4648	AP-42	HDDV @ 1995 Fleet, <4000ft
Semi-Trucks	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Crawler Crane	0.003	0.023	Table A-9-8-B	Cranes (D)
Backhoe-1-1/2 cy Bucket	0.003	0.022	Table A-9-8-B	Trctr/Lodr/Bakho (D)
Backhoe w/Demolition Attachment	0.003	0.022	Table A-9-8-B	Trctr/Lodr/Bakho (D)
Crane -15T to 35T Capacity	0.003	0.023	Table A-9-8-B	Cranes (D)
Dozer	0	0	Table A-9-8-A	Wheeled Dozer (D)
Scraper/Pan	0.27	3.84	Table A-9-8-A	Scraper (D)
Motor Grader	0.039	0.713	Table A-9-8-A	Motor Grader (D)
Plate Compactor	0.043	0.004	Table A-9-8-B	Plate Compctr (4 strk) (G)
Front End Loader	0.002	0.023	Table A-9-8-B	Rubber Tired Loader (D)
Roller	0.065	0.87	Table A-9-8-A	Roller (D)
Water Truck	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Paving Machine	0.002	0.024	Table A-9-8-B	Paving Equip (2/4 strk) (D)
Skip Loader	0.004	0.021	Table A-9-8-B	Skid-Steer Loader (D)
Service Truck	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Bucket Truck	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Line Truck	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Trencher	0.003	0.022	Table A-9-8-B	Trenchers (D)
Manlift	0.003	0.031	Table A-9-8-B	Aerial Lifts (D)
750-cfm Air Compressor	0.054	0.002	Table A-9-8-B	Air Compressor <50 hp (G)
375-cfm Air Compressor	0.002	0.018	Table A-9-8-B	Air Compressor <50 hp (D)
300-amp Welding Machine	0.002	0.018	Table A-9-8-B	Welders <50 hp (D)
600-amp Welding Machine	0.002	0.018	Table A-9-8-B	Welders <50 hp (D)
600-amp Shear Stud Welder	0.054	0.002	Table A-9-8-B	Welders <50 hp (G)
Forklift	0.003	0.031	Table A-9-8-B	Fork Lift (D)

(a) CEQA Air Quality Handbook unless otherwise specified

TABLE S-9
Emissions Factors for Boeing Construction Equipment

Equipment	Emission Factors for Criteria Pollutants (lbs/hr and lbs/hp-hr)			
Type	ROC	NOx	Reference (a)	Equipment Class
Trencher (Diesel)	0.003	0.022	Table A-9-8-B	Trenchers
Backhoe (Diesel)	0.003	0.022	Table A-9-8-B	Trctr/Lodr/Bakho
D-B Bull Dozer (Diesel)	0	0	Table A-9-8-A	Wheeled Dozer
977 Front End Loader (Diesel)	0.002	0.023	Table A-9-8-B	Rubber Tired Loader
12CY Dump Truck (Diesel)	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Plate Compactor (Gas)	0.043	0.004	Table A-9-8-B	Plate Compctr (4 strk)
Sheeps Foot (Diesel)	0.065	0.87	Table A-9-8-A	Roller
Motor Grader CAT 12G (Diesel)	0.039	0.713	Table A-9-8-A	Motor Grader
Excavator CAT 235 (Diesel)	0.001	0.024	Table A-9-8-B	Excavator
Welding Machines (Gas)	0.054	0.002	Table A-9-8-B	Welders <50 hp
125-Ton Crane (Diesel)	0.003	0.023	Table A-9-8-B	Cranes
230-Ton Crane (Diesel)	0.003	0.023	Table A-9-8-B	Cranes
45-Ton Cherry Picker (Diesel)	0.003	0.031	Table A-9-8-B	Aerial Lifts
5-Ton Fork Lift (Diesel)	0.003	0.031	Table A-9-8-B	Fork Lift (D)
80-Ft Man Lift (Gas)	0.003	0.031	Table A-9-8-B	Aerial Lifts (G)
Flat Bed Truck (Gas)	0.09287	0.4648	AP-42	HDDV@1995 Fleet <4000ft
Cars, Pick-ups (Gas)	0.09287	0.4648	AP-42	HDDV@1995 Fleet <4000ft
Asphalt Paver (Diesel)	0.001	0.023	Table A-9-8-B	Asphalt Pavers
Water Truck (Diesel)	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Air Compressor (Gas)	0.054	0.002	Table A-9-8-B	Air Compressor <50 hp
Semi-Truck Deliveries (General)	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Concrete Trucks	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
Semi-Truck Deliveries (Steel)	0.002	0.021	Table A-9-8-B	Dumpers/Tendors
500-HP Dredge (Diesel)	0.0006	0.0086	Table A-9-3-A	Reciprocating Diesel Engine
750-HP Tugboats (Diesel)	0.0006	0.0086	Table A-9-3-A	Reciprocating Diesel Engine

(a) CEQA Air Quality Handbook unless otherwise specified

TABLE S-10
Emission Sources for Operation-Related Mobile Sources (Part 1 of 2)

Operation Activity	Emission Source	Description
Infrastructure	Privately Owned Vehicle (POV) traffic	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors and the following assumptions: on-base vehicle speed is 25 mph, off-base vehicle speed is 50 mph, distribution of employee residences same as 1997 socioeconomic study for VAFB, average vehicle ridership is 1.5 (per CEQA Air Quality Handbook), non-work trip length included in total off-base VMT, ratio of non-work trip distance to work trip distance of 0.768, POVs 81.6% light-duty automobiles and 18.4% light-duty trucks, trips occur regardless of whether a launch occurs, and trips occur 360 days per year.
	Delivery Truck Traffic	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors and the following assumptions: on-base vehicle speed is 25 mph, off-base vehicle speed is 50 mph, delivery trucks are a mixture of light-duty and medium-duty trucks, trips occur regardless of whether a launch occurs, and trips occur 360 days per year.
Launch of either an Atlas V or a Delta IV	Launch Related Personnel Traffic	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors and the following assumptions: on-base vehicle speed is 25 mph, off-base vehicle speed is 50 mph, distribution of employee residences same as 1997 socioeconomic study for VAFB, average vehicle ridership is 1.5 (per CEQA Air Quality Handbook), non-work trip length included in total off-base VMT, ratio of non-work trip distance to work trip distance of 0.768, POVs 81.6% light-duty automobiles and 18.4% light-duty trucks, and trips occur on a per launch basis.
	Launch Related Truck Traffic	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors and the following assumptions: on-base vehicle speed is 25 mph, off-base vehicle speed is 50 mph, trucks are a mixture of light-duty and heavy-duty trucks, and trips occur on a per launch basis.
	Aircraft traffic	Emissions in Santa Barbara County were calculated using emission factors from EDMS, and the following assumptions: aircraft are a mixture of C-5s, C-17s, and C-141, and trips occur on a per launch basis.

TABLE S-10
Emission Sources for Operation-Related Mobile Sources (Part 2 of 2)

Operation Activity	Emission Source	Description
Launch of a Delta IV	Barge traffic	Emissions in Santa Barbara County were calculated using manufacturer-supplied emission factors and the distance traveled within Santa Barbara County. One barge per launch was assumed.
Launch of a Delta IV (5,2)/(5,4)	Transport of Flushing Water	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors for heavy-duty trucks and the distance the traveled within Santa Barbara County. Twelve truck trips per launch were assumed.
Launch of an Atlas V	Transport of Deluge Water	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors for heavy-duty trucks and the distance the traveled within Santa Barbara County. Sixty truck trips per launch were assumed.
Launch of either an Atlas V 500 or a Delta IV (5,2)/(5,4)	Transport of Solid Rocket Motors	Emissions in Santa Barbara County were calculated using EMFAC7 emission factors for heavy-duty trucks and the distance traveled within Santa Barbara County. One truck per solid rocket motor was assumed.

References

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Appendix T
REEDM Methods of Analysis

This appendix describes computer model results used to estimate the potential effects of both normal launches and early flight launch failures of the proposed Evolved Expendable Launch Vehicle (EELV) on the air chemistry near Vandenberg Air Force Base (VAFB) and Cape Canaveral Air Station (CCAFS). On the basis of public comments on the Draft Supplemental Environmental Impact Statement (DSEIS), the air quality analysis was refined. This included refinements of the vehicle database and in the handling of aluminum oxide particulates. Also, an additional launch failure case (the conflagration mode), two new meteorological cases for CCAFS, and a new normal launch scenario (enough deluge water flowing to saturate the launch cloud) have been included in response to comments on the DSEIS. All cases modeled in the DSEIS were remodeled, as well as the additional cases. Details of the modeling for each case, new and old, are given in this appendix. In addition, in the interim since the calculations for the DSEIS were performed, a newer version of the Rocket Exhaust Effluent Diffusion Model (REEDM), version 7.09, has become available. This newer version was used for all cases modeled in the current document. Reference 1 describes the modeling done for the DSEIS (Ref. 1).

The principal modeling results are from the REEDM, version 7.09 (Ref. 2-3). Preliminary work covered several proposed EELV vehicles, and was summarized in the 1998 FEIS. This appendix refers to vehicle variants with solid rocket motors, one from each EELV launch vehicle contractor. The methodology and a description of the computer models appear in References 1 and 2. Other models are available that address the kinetics of chemical reactions expected to occur in the rocket plume as it disperses (Ref. 4,5).

The vehicles treated here are the Boeing Delta IV M+ (5,4), which employs four solid strap-on motors, and the Lockheed Martin Atlas V 551/552, which employs five solid strap-on motors. For the purposes of the air quality analyses, these configurations were selected as the bounding cases. The total propellant loads, propellant composition, propellant burn rates, motor chamber pressure, propellant grain dimensions versus time and nominal flight trajectories were obtained from data provided by the launch vehicle contractors. Prior to performing REEDM calculations, vehicle databases were generated using standard practices employed at VAFB and CCAFS for current operational launch vehicles.

The solid rocket motors, which burn aluminum based fuel, are expected to produce aluminum oxide particles less than 10 microns in diameter. On the basis of DSEIS comments provided on potential PM_{10} emissions, the historical REEDM assignment of aluminum oxide particle sizes and mass distribution were re-examined and modified for the EELV motors. Historically REEDM has used 10 particle size categories ranging from 115 to 870 microns, each with a settling velocity of 0.1078 meters/second. The origins of these particle size categories are not documented and were noted to be inconsistent with the smaller particle sizes reported in the literature for solid rocket motors (Ref. 6,7,8). Therefore, the REEDM aluminum oxide particle size distributions were recomputed using the Beiting model. The expected particles were partitioned into 10 size category "bins" ranging from 0.95 to 9.95 microns in diameter. An

average gravitational settling velocity was computed for each particle size category using the Stoke's Law relationship that balances the gravitational force with the viscous drag force. The computed settling velocities ranged from 0.0001 to 0.0049 m/sec.

Effluents from a normal launch were calculated using the NASA Lewis Computer Program for Calculating Complex Chemical Equilibria (CET93) computer code (Ref. 9). To cover a range of possible sound suppression design configurations, "dry" and "wet" normal launch ground clouds were simulated in the REEDM analyses. The ground cloud is defined as that amount of propellant exhaust emitted from the launch vehicle that physically interacts with the launch pad flame trench, pad structures and water deluge systems (if present). Based on observations from existing vehicles similar to the EELV, emissions from the vehicle until the nozzles are 160 meters above the pad were assumed to contribute to the formation of the ground cloud. For the purposes of the bounding REEDM analyses, the "dry" ground cloud assumed no sound suppression water whereas the "wet" ground cloud assumed sufficient water injection to just saturate the cloud. The normal launch emissions from the vehicle ascent above 160 meters are assumed to be dry in all cases. The "wet" condition minimizes the thermal buoyancy of the ground cloud; the "dry" condition maximizes the thermal buoyancy. The net thermal buoyancy of the rocket exhaust is one of several critical factors affecting the rise of the hot exhaust to a final neutral density stabilization height. Higher cloud stabilization heights equate to lower ground level concentrations of exhaust pollutants. Partial afterburning effects were also simulated in the propellant combustion analysis. Partial afterburning is conservative from a safety and environmental assessment perspective in that buoyancy is reduced and carbon monoxide is favored over carbon dioxide when compared to a complete afterburning assumption. The initial REEDM mass compositions for the EELV normal launch exhaust were calculated as the mixture of solid rocket motor exhaust, core vehicle liquid motor exhaust, entrained air and injected water (if present). Entrainment of ambient air into the buoyant ground cloud is a critical parameter affecting the stabilized cloud height. The REEDM EELV analyses utilized an empirically derived air entrainment rate based on data collected from eleven Titan IV launch clouds.

REEDM analyses were also performed to characterize the chemical emissions associated with launch vehicle catastrophic failures. Since the EELV variants being considered in this appendix contain both liquid propellant and solid propellant stages, two types of emission sources exist. Following a launch failure, the liquid propellant storage tanks are ruptured at the breakup altitude of the launch vehicle producing a liquid propellant fireball that reacts in a matter of seconds. REEDM refers to the liquid propellant fireball as a "deflagration" event. The solid strap-on motors are also expected to breakup during a launch failure. This breakup may occur due to mechanical failure of the solid rocket motor itself (e.g. over-pressurization or aerodynamic load failure) or by initiation of shaped high explosive ordinance designed to cut through the motor casing. In either event, the case failure allows for sudden expansion of the internal solid rocket motor pressure, which shatters the propellant and ejects burning propellant fragments from the breakup location. These ejected fragments fall to the ground from the breakup altitude and burn for several minutes until consumed. REEDM refers to the burning solid propellant fragments as a "conflagration" event.

In order to evaluate the conflagration scenarios for the Delta IV M+ (5,4) and the Atlas V 551/552 vehicles, a computer model was run to calculate the solid rocket motor break-up characteristics such as fragment sizes, ballistic coefficients and explosion induced velocities as a function of flight failure time. The fragmentation data was then processed using a statistical

003670087computer program designed to calculate drag corrected impact locations for each ballistic coefficient and explosion induced velocity fragment group. This program is the same program that has been used for many years to calculate debris risk and destruct lines for Air Force and NASA missions flying from VAFB and CCAFS. The resulting propellant impact location, impact area, residual propellant mass and burn rate information were input to REEDM as a function of early flight failure times to support calculation of the conflagration scenario chemical emissions from burning solid propellant fragments. Delta IV failures were simulated at 0, 4, 8, 12, 16, and 20 seconds into flight. Atlas V failures were simulated at 0, 6, 12, 18, 24, and 30 seconds into flight. Chemicals of primary concern in the solid propellant exhaust are hydrogen chloride gas and aluminum oxide particulates. Carbon monoxide and traces of NO_x may also be produced in the open burn of the Hydroxyl Terminated Polybutadiene (HTPB) propellant. The highest ground level HCl concentrations are typically predicted to occur in association with an early in-flight failure as opposed to an on-pad failure or late flight failure. The total propellant surviving to ground impact, the size of the propellant impact area and the average propellant burn rate each affect the ensuing exhaust cloud in different and offsetting ways.

The REEDM analyses of Delta IV and Atlas V liquid core vehicle deflagration scenarios required specification of propellant mixing assumptions. During a launch failure the liquid propellants are not expected to be efficiently mixed or completely reacted. Evidence and experience from past launch vehicle failures and liquid propellant explosion test programs support this conjecture. For this reason, REEDM assigns the liquid propellant load on the vehicle at the failure time to combustion, vaporization, thermal decomposition and/or afterburning reaction pathways. The propellant mixing assumptions and partitioning coefficients used to characterize the EELV deflagration scenarios were drawn from similar assumptions made for existing Titan, Delta and Atlas launch vehicles. However, new assumptions were necessary to characterize the post-launch failure mixture of liquid hydrogen and liquid oxygen, which had not yet been considered in previous REEDM launch vehicle scenarios. For these cryogenic fuels it was assumed that 70% of the hydrogen reacted with available oxygen and the remainder was vaporized. This is believed to be a conservative estimate tending toward lower cloud buoyancy and higher predicted ground level pollutant concentrations. In addition to the liquid propellants, the REEDM deflagration mode allows for the possibility of partial mixing of solid propellant exhaust with the liquid fireball. Based on an analysis of the 1986 Titan 34D-9 failure at Vandenberg, it was estimated that 5% of the available solid rocket propellant mass was mixed with the liquid fireball during the vehicle explosion. The EELV analyses also assumed 5% of available solid propellant was mixed into the deflagration cloud.

Each of the EELV medium lift boosters will fly several different missions from each launch site. For the purposes of this analysis a low earth orbit mission trajectory profile was selected as the launch profile with the slowest ascent rate through the early flight phase. This scenario is associated with the largest deposits of rocket exhaust in the lower 10,000 feet of the atmosphere. REEDM only analyzes the transport and diffusion of exhaust material within the lower 10,000 feet of the atmosphere. Both EELV launch vehicles may fly with fewer strap-on solid rocket motors than the configurations evaluated in this appendix. Those missions would be expected to be more benign with respect to normal launch toxic emissions than the values cited in this appendix.

Meteorological conditions at the time of launch are a critical factor in the behavior of rocket exhaust buoyant cloud rise and subsequent downwind transport and diffusion. The most important factor is the vertical temperature profile of the lower atmosphere, followed in importance by the wind speed and direction vertical profiles. As with classical air pollution meteorology, the presence of stable air layers determines whether or not emissions will get trapped near the ground surface or will mix through a deeper, well ventilated air volume. REEDM treats the stable air layer associated with a temperature inversion as a capping layer that blocks transport of gases across the layer. Thus the presence of a temperature inversion and its proximity to the thermally stabilized rocket exhaust cloud are significant parameters affecting ground level concentrations of rocket exhaust gases. Rocket exhaust aluminum oxide particulates are influenced by gravitational settling as well as atmospheric turbulence. REEDM assumes that particles subject to gravitational settling can penetrate through a temperature inversion even though the transport of gases would be inhibited across the same layer.

Several meteorological cases were investigated for each launch site. The central coast of California is characterized by the presence of a strong and persistent subsidence temperature inversion. This inversion exhibits seasonal variations in height and strength and is occasionally absent, primarily during winter months. Temperature inversions also occur at Cape Canaveral, either in association with frontal systems or the formation of the diurnal convective boundary layer. At the Cape the temperature inversions tend to be weaker and higher above the ground than the Vandenberg inversions. The following four meteorological cases were selected for REEDM analyses of simulated Vandenberg EELV launch and launch failure scenarios:

1. Case VAFB1. An October 1997 late afternoon sounding taken in association with a Titan launch. The profile exhibits a neutral stability surface layer extending from the ground to the base of a well-defined elevated temperature inversion at 3150 feet above the ground. Winds are from the northwest, moderate in speed with little directional shear. Measured turbulence values for the first 400 meters of the surface layer are included.

2. Case VAFB2. A December 20 1996 late morning sounding taken in association with a Titan launch. A neutral surface layer from the ground to the base of a very weak mid-level inversion based at 1500 feet above the ground is characterized by very light winds and large amounts of directional shear. Another wind direction shear zone exists across the weak inversion. Above the inversion winds are from the northwest, light to moderate in speed and with less directional shear. Turbulence measurements are included. For some runs Case VAFB2 has been modified by removing the large directional wind shear. Excessively large wind shears present a problem for REEDM causing the program to overestimate the cloud passage time over downwind receptor locations. Removal of the wind shear eliminates this problem. The modified Case VAFB2 can be described as a "no-shear" condition.

3. Case VAFB3. A May 12 1996 afternoon sounding taken in association with a Titan launch. Winds are light to moderate in the surface layer, which extends from the ground to the base of a strong, low level inversion at 650 feet above the ground. The potential temperature increases by 10 degrees Celsius across 400 feet of the inversion indicating a very stable layer of air. Measured turbulence is not included; hence REEDM uses an empirical and theoretical climatological turbulence model in place of the missing measured turbulence values.

These three cases cover a range of typical launch conditions experienced at VAFB. They were not intended, nor are they required, to capture statistically worst case conditions for the

transport and diffusion of rocket emissions. However, Case VAFB3, with the strong low level inversion represents what could be deemed "adverse" conditions from a rocket emission dispersion perspective.

At this point, a more detailed motivation for the modification of Case VAFB2 will be given. This case is based on the last rawinsonde balloon release before the launch of the Titan IV K-13 mission that flew out of Vandenberg on December 20, 1996. The meteorology of the sounding exhibits very light winds (i.e. 1 to 3 meters/second) and nearly neutral atmospheric stability from the ground up to the base of a weak temperature inversion that starts at about 1500 feet above the ground. In this lower neutral layer the light winds show a high degree of wind direction variability. Near the ground the winds are from a bearing of 56 degrees, then a couple hundred feet up the winds are from 167 degrees, then shift back to 42 degrees and then to 292 degrees near the base of the inversion. Across the inversion is another strong directional shear zone with winds shifting to 345 degrees above the inversion and picking up in speed. The expected effect of all this directional shear is to tear the launch column exhaust cloud into pieces that tend to transport in the direction of the wind at that altitude. As particulates settle toward the ground, their path or trajectory while falling is also affected by the wind shear in the layers through which the particles fall.

Conceptually this is not a problem. REEDM, however, is a Gaussian dispersion model, which means it requires a single average wind speed and wind direction in the mathematical algorithm that computes the downwind concentrations. REEDM uses a weighted averaging scheme to compute the average transport wind speed and direction. In this K13 profile, REEDM computed average wind directions of 354 degrees below the inversion and 338 degrees above the inversion. To compute the time weighted average concentrations along the average transport direction, REEDM makes an estimate of cloud arrival and cloud departure times for each downwind distance increment (1 kilometer step in this case) along the path of the average transport direction. REEDM partitions the exhaust cloud column into "disks" of cloud material that correspond to layers of the atmosphere defined from the rawinsonde sounding measurements. For example, the Case VAFB2 data file has a measurement at 657 feet above sea level where the winds were measured at 1.7 knots from 66 degrees. The next measurement level at 821 feet shows wind at 2.3 knots from 42 degrees. REEDM would assign cloud material in this layer to a "disk" 164 feet thick, centered at 739 feet above sealevel with an average wind speed of 2.0 knots from 54 degrees. This particular "disk" would transport 60 degrees to the west of the "average" direction for all cloud disks. REEDM estimates the arrival time as that time when the leading edge of the fastest moving "disk" just reaches the downwind receptor location. The cloud departure time is estimated as that time when the slowest moving "disk" just leaves the receptor location.

For Case VAFB2, REEDM predicted the peak Al_2O_3 ground level concentration of 2.9 mg/m^3 occurred at a distance of 5 kilometers from the launch site with an arrival time of 33 minutes (5000 m/1980 sec = wind speed of 2.5 m/sec) and a departure time of 295 minutes (5000 m/ 17700 sec = wind speed of 0.28 m/sec). The departure time suggests a very slow wind speed and is the result of the wind shear moving one or more cloud disks at an angle away from the average transport direction. In fact, if a disk transported at 90 degrees relative to the average transport direction, it would have zero velocity component in the average downwind direction and would never arrive at the designated downwind receptor. REEDM includes logic to check for disks that move sideways or upwind from the main transport direction, but the logic in the algorithm is still weak for these high wind shear cases. The departure time is biased by disks

that move away from the downwind receptor and particulates or gas originating in this disk are unlikely to actually contribute to the concentration at the receptor location being evaluated because they are angling away from the receptor as they transport.

Due to REEDM limitations for treatment of dispersion under high wind shear conditions, the Case VAFB2 meteorological file was deliberately modified to remove all wind directional shear. This forces all exhaust material to follow the same transport path and would be expected to create relatively high ground concentrations (since wind shear is not dispersing the cloud material) and very reasonable cloud passage times for the observed wind speeds in the average transport direction. Using this "no shear" meteorological case, identified as modified Case VAFB2, (2m in the Tables) REEDM better predicts the true cloud passage time. The results from all the REEDM runs, with raw and with modified meteorological data, are shown in the tables in the next section. The runs with the modified data are shown in the plots of the downwind PM10 concentrations. The runs with the raw data are shown in the downwind concentration plots for HCl, and CO.

Four meteorological soundings were also evaluated for EELV launch simulations from CCAFS. Measured turbulence values are not routinely available at the Eastern Range; therefore REEDM used climatologically derived turbulence parameters for all CCAFS analyses. The sounding characteristics are described as follows:

1. Case CCAFS1. An April 24, 1996 afternoon sounding taken in association with a Titan launch. A well-defined temperature inversion with a 6 degree Celsius gradient over 200 feet has a base at 3450 feet above the ground. Winds from the ground to the inversion base are primarily from the north shifting to westerly winds above the inversion. The surface layer is moist and near neutral stability.

2. Case CCAFS2. A January 22, 1996 nighttime sounding with a deep surface layer of moist air associated with a cold front over southern Florida. A mild surface based inversion exists of approximately 1 degree C differential and a stronger elevated inversion exists at 6000 feet above the ground. Winds in the surface layer are moderate speed from the northeast. Above the inversion the airflow is drier and from the northwest.

3. Case CCAFS3. A September 25, 1992 predawn sounding with a weak inversion based at 4900 feet. Winds below the inversion are from the east to southeast. This surface layer is moist with near neutral stability. There is little shear across the inversion with air above the inversion being slightly stable. This meteorological case describes a high over the eastern United States, producing easterly winds with a potential for causing adverse inland toxic hazard corridors. This case features a vertically uniform wind direction with light wind speeds at approximately 7 meters per second for most of the mixing layer. The light uniform winds make this scenario a case of interest for particulate deposition analyses.

4. Case CCAFS4. A July 2, 1996 nighttime sounding taken in association with a Titan launch. The profile is characterized by a weak ground based stable layer above which is a deep layer of neutral stability air. The ground based stable layer is indicative of the formation of a nocturnal radiation inversion that forms as the ground cools during the night more quickly than the air.

The stable surface layer found in Case CCAFS4 constitutes a potentially "adverse" condition. When the exhaust cloud has reduced thermal buoyancy, as in the conflagration clouds produced at flight failure times beyond 12 seconds, a significant portion of the cloud can get

trapped in the stable surface layer causing high ground level concentrations. The four meteorological cases selected for the CCAFS REEDM analysis represent a range of credible launch conditions. They are not intended to reflect the possible extremes under which a launch could occur; rather they cover a range of conditions from adverse to benign from an airborne chemical dispersion perspective. They also serve to demonstrate the variability of downwind concentration predictions induced by the variability in meteorological conditions.

The REEDM analysis did not include terrain effects. A dry deposition velocity of 3 cm/sec was applied to HCl gas. For all other chemical species the dry deposition velocity was set to zero. The HCl deposition velocity has a minor effect (typically less than 2%) on the downwind concentrations. Ground deposition cases are considered separately. Given the uncertainty in meteorological conditions, propellant mixing assumptions, vehicle break up characteristics, air entrainment rates etc., the REEDM predictions for any given scenario could be in error by a factor of 2 to 3. The analyses presented in this appendix represent the best available technology currently in use by the operational launch support safety community.

The REEDM results for peak ground level effluent concentrations, maximum 30 minute time-weighted average (TWA) concentration, and maximum 60 minute TWA are given in the following four tables. Each table is for a specific vehicle at a specific launch site. The concentrations are given for aluminum oxide (Al_2O_3), hydrochloric acid gas (HCl), carbon monoxide (CO), nitric oxide (NO_2), kerosene fuel vapors (RP-1 gas), ammonia (NH_3), and hydrazine(N_2H_4). A detailed description of the tables along with the tables themselves appear in the next section.

In addition, the ground level downwind instantaneous peak concentrations as a function of distance are presented in figures 1-20. REEDM does not track gas concentrations below 5×10^{-4} ppm; concentrations near or below this cut-off are not plotted. Normal launch concentrations for dry and wet launch conditions for meteorological conditions giving tracked concentrations are plotted for HCl, CO, and PM10. In addition, launch failure concentrations are given for HCl, and CO. Examining the plots shows that weather conditions and timing of the failure for conflagration events have a great impact on the peak downwind concentrations.

Tables

The REEDM results for peak ground level effluent concentrations, maximum 30 minute time-weighted average (TWA) concentration, and maximum 60 minute TWA are given in the following four tables. Each table is for a specific vehicle at a specific launch site. The concentrations are given for aluminum oxide (Al_2O_3), hydrochloric acid gas (HCl), carbon monoxide (CO), nitric oxide (NO_2), kerosene fuel vapors (RP-1 gas), ammonia (NH_3), and hydrazine(N_2H_4). Gas phase concentrations are given in parts per million by volume (ppm); particle concentrations are given in milligrams per cubic meter (mg/m^3). The distance in kilometers downwind of the launch pad where the peak concentration occurs is given in the tables after the concentration, separated by the @ symbol. These concentrations are given for normal launch, conflagration, and deflagration emission modes, for both vehicles and for each meteorological case. Meteorological cases are referred to by number; full descriptions of the case each number refers to for each launch site is presented earlier in this appendix. The database column refers to the sound suppression water used; 'dry' means no water was used, 'wet' means enough sound suppression water was used to saturate the ground cloud (i.e., 30,000 gallons for the Atlas V 551/552 and 15,000 gallons for the Delta IV M+ (5,4)). Mode refers to whether the modeled launch was normal (normal), a deflagration launch failure (defl), or a conflagration launch failure (conf). For the conflagration mode the time after ignition of the failure is also shown. More details on modeling launch failures are presented earlier in this appendix. The stabilization height (Stab. Ht.) of the toxic cloud predicted by REEDM is given in meters; the higher the stabilized cloud, the lower the ground level concentrations. Maximum ground deposition of aluminum oxide particles in milligrams per square meter (mg/m2) and acidity of deposited HCl droplets (pH) are given in the tables for light rain conditions; the rain precipitation rates (in./hr) were chosen to be consistent with conditions under which actual launches occur.

REEDM Version 7.09 Analysis Results for Atlas V 551/552 Vandenberg Cases - Gaseous Concentrations

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 Peak Conc. [mg/m³]	Al_2O_3 30 Min TWA [mg/m³]	Al_2O_3 60 Min TWA [mg/m³]	HCl Peak Conc. [ppm]	HCl 30 Min TWA [ppm]	HCl 60 Min TWA [ppm]	CO Peak Conc. [ppm]	CO 30 Min TWA [ppm]	NO_2 Peak Conc. [ppm]	NO_2 30 Min TWA [ppm]	NO_2 60 Min TWA [ppm]	RP-1 gas Peak Conc. [ppm]	RP-1 gas 30 Min TWA [ppm]	RP-1 gas 60 Min TWA [ppm]	NH_3 Peak Conc. [ppm]	NH_3 30 Min TWA [ppm]	NH_3 60 Min TWA [ppm]	N_2H_4 Peak Conc. [ppm]	N_2H_4 30 Min TWA [ppm]	N_2H_4 60 Min TWA [ppm]
1	dry	t-0 conf.	1160	2.156 @ 9	0.277 @ 10	0.139 @ 10	1.272 @ 9	0.123 @ 10	0.062 @ 10	0.190 @ 9	0.018 @ 10	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+6 conf.	1002	3.487 @ 9	0.465 @ 10	0.233 @ 10	2.053 @ 9	0.213 @ 10	0.107 @ 10	0.307 @ 9	0.032 @ 10	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+12 conf.	964	1.800 @ 12	0.236 @ 12	0.119 @ 12	0.929 @ 12	0.108 @ 12	0.054 @ 12	0.139 @ 12	0.016 @ 12	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+18 conf.	936	1.090 @ 13	0.160 @ 13	0.080 @ 13	0.615 @ 13	0.071 @ 13	0.035 @ 13	0.092 @ 13	0.011 @ 13	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+24 conf.	923	0.679 @ 13	0.088 @ 13	0.044 @ 13	0.385 @ 13	0.039 @ 13	0.020 @ 13	0.058 @ 13	0.006 @ 13	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+30 conf.	917	0.274 @ 12	0.030 @ 13	0.015 @ 13	0.156 @ 13	0.014 @ 13	0.007 @ 13	0.023 @ 13	0.002 @ 13	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t-0 conf.	1456	0.844 @ 13	0.532 @ 13	0.300 @ 13	0.054 @ 2	0.022 @ 2	0.011 @ 3	0.008 @ 2	0.003 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+6 conf.	1264	1.318 @ 11	0.867 @ 11	0.506 @ 11	0.084 @ 2	0.039 @ 3	0.021 @ 3	0.013 @ 2	0.008 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+12 conf.	695	2.502 @ 6	2.172 @ 5	1.866 @ 5	0.440 @ 2	0.318 @ 3	0.184 @ 3	0.086 @ 2	0.048 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+18 conf.	652	1.832 @ 5	1.743 @ 5	1.587 @ 5	0.822 @ 2	0.603 @ 3	0.357 @ 3	0.124 @ 2	0.082 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+24 conf.	527	1.046 @ 5	0.991 @ 5	0.877 @ 5	0.575 @ 2	0.400 @ 3	0.232 @ 3	0.087 @ 2	0.061 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+30 conf.	532	0.406 @ 5	0.379 @ 5	0.326 @ 5	0.203 @ 2	0.134 @ 3	0.078 @ 3	0.031 @ 2	0.020 @3	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t-0 conf.	714	3.924 @ 10	0.819 @ 11	0.410 @ 11	0.376 @ 2	0.027 @ 2	0.013 @ 2	0.057 @ 2	0.004 @ 2	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+6 conf.	478	12.439 @ 6	2.690 @ 7	1.345 @ 7	0.950 @ 2	0.106 @ 2	0.053 @ 2	0.143 @ 2	0.018 @ 2	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+12 conf.	282	16.570 @ 3	3.226 @ 4	1.613 @ 4	4.017 @ 2	0.622 @ 2	0.311 @ 2	0.603 @ 2	0.093 @ 2	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+18 conf.	275	9.426 @ 4	1.912 @ 4	0.956 @ 4	2.263 @ 3	0.376 @ 3	0.188 @ 3	0.342 @ 3	0.057 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+24 conf.	275	5.881 @ 3	1.021 @ 4	0.510 @ 4	1.352 @ 3	0.202 @ 3	0.101 @ 3	0.205 @ 3	0.031 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+30 conf.	275	2.349 @ 3	0.353 @ 4	0.176 @ 4	0.558 @ 2	0.070 @ 2	0.035 @ 2	0.084 @ 2	0.011 @ 3	0	0	0	0.390 @ 8	0.015 @ 9	0.006 @ 9	0.036 @ 8	0.001 @ 9	0.001 @ 9	0.002 @ 8	0	0
1	dry	t-0 defl	1013	0.122 @ 8	0.006 @ 9	0.003 @ 9	0.275 @ 8	0.011 @ 9	0.005 @ 9	10.800 @ 8	0.416 @ 9	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t-0 defl	949	0.099 @ 8	0.034 @ 8	0.018 @ 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t-0 defl	650	0.130 @ 8	0.014 @ 10	0.007 @ 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	normal	1030	2.386 @ 12	0.100 @ 9	0.050 @ 9	1.569 @ 7	0.056 @ 8	0.028 @ 8	1.463 @ 7	0.052 @ 8	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	normal	1152	0.948 @ 10	0.319 @ 12	0.160 @ 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	normal	1144	0.208 @ 19	0.057 @ 24	0.029 @ 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	wet	normal	994	2.694 @ 8	0.116 @ 9	0.058 @ 9	1.896 @ 8	0.067 @ 9	0.033 @ 9	1.334 @ 8	0.047 @ 9	0	0	0	0	0	0	0	0	0	0	0	0
2	wet	normal	931	2.222 @ 8	0.718 @ 8	0.361 @ 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	wet	normal	486	5.401 @ 6	0.601 @ 7	0.251 @ 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t-0 conf	1456	1.192@14	0.500@17	0.252@18	0.138@2	0.019@3	0.009@3	0.021@2	0.003@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+4 conf	1249	1.686@12	0.672@14	0.337@14	0.156@3	0.031@3	0.016@3	0.024@3	0.005@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+8 conf	679	3.418@5	1.270@5	0.636@5	0.748@3	0.265@3	0.132@5	0.113@3	0.040@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+12 conf	541	3.583@4	1.391@4	0.697@4	1.312@3	0.490@3	0.245@3	0.198@3	0.074@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+16 conf	516	2.348@3	0.852@3	0.427@3	0.933@3	0.323@3	0.161@3	0.141@3	0.049@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+20 conf	520	0.879@3	0.285@3	0.142@3	0.340@3	0.107@3	0.053@3	0.051@3	0.016@3	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	defl	998	0.099@9	0.015@10	0.008@10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	normal	1152	1.193@11	0.230@14	0.115@14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2m	wet	normal	973	2.267@9	0.316@11	0.158@11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

REEDM Version 7.09 Analysis Results for Atlas V 551/552 Vandenberg Cases - Rain Washout Deposition

Met Case	Database	Mode	Stab. Hgt. [m]	Al2O3 0.05 in/hr [mg/m³]	Al2O3 0.10 in/hr [mg/m³]	HCL 0.05 in/hr [pH]	HCL 0.10 in/hr [pH]
1	dry	normal	1030	897 @ 2	1353 @ 1	-0.2 @ 1	-0.3 @ 1
2	dry	normal	1152	3140 @ 1	4715 @ 1	-0.2 @ 1	-0.3 @ 1
3	dry	normal	1144	2013 @ 3	3025 @ 3	-0.2 @ 3	-0.3 @ 3
1	wet	normal	994	957 @ 2	1442 @ 2	-0.2 @ 2	-0.3 @ 2
2	wet	normal	931	3673 @ 1	5516 @ 1	-0.2 @ 1	-0.3 @ 1
3	wet	normal	486	3170 @ 1	4774 @ 1	-0.2 @ 1	-0.3 @ 1
1	dry	t-0 conf	1160	1056 @ 3	1579 @ 3	0.829 @ 3	0.955 @ 3
2	dry	t-0 conf	1457	2675 @ 1	3967 @ 1	0.871 @ 1	0.801 @ 1
3	dry	t-0 conf	714	4122 @ 1	6150 @ 1	0.318 @ 1	0.445 @ 1
4	dry	normal	1152	2840@1	4262@1	-0.2 @ 1	-0.3 @ 1
4	wet	normal	973	3677@1	5520@1	-0.2 @ 1	-0.3 @ 1
4	dry	t-0 conf	1455	2882@1	4278@1	0.818@1	.740@1

REEDM Version 7.09 Analysis Results for Delta IV M+4 Vandenberg Cases - Gaseous Concentrations

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 Peak Conc. [mg/m³]	Al_2O_3 30 Min TWA [mg/m³]	Al_2O_3 60 Min TWA [mg/m³]	HCl Peak Conc. [ppm]	HCl 30 Min TWA [ppm]	HCl 60 Min TWA [ppm]	CO Peak Conc. [ppm]	CO 30 Min TWA [ppm]	CO 60 Min TWA [ppm]
1	dry	t-0 conf	994	2.261 @ 10	0.274 @ 10	0.137 @ 10	1.378 @ 10	0.129 @ 10	0.064 @ 10	2.273 @ 10	0.213 @ 10	0.106 @ 10
1	dry	t+4 conf	979	2.258 @ 10	0.280 @ 10	0.140 @ 10	1.360 @ 10	0.132 @ 10	0.066 @ 10	2.243 @ 10	0.218 @ 10	0.109 @ 10
1	dry	t+8 conf	964	1.872 @ 12	0.247 @ 12	0.123 @ 12	1.126 @ 12	0.115 @ 12	0.058 @ 12	1.858 @ 12	0.191 @ 12	0.095 @ 12
1	dry	t+12 conf	778	1.609 @ 12	0.211 @ 12	0.106 @ 12	1.014 @ 12	0.102 @ 12	0.051 @ 12	1.674 @ 12	0.168 @ 12	0.084 @ 12
1	dry	t+16 conf	707	1.345 @ 11	0.170 @ 11	0.085 @ 11	0.877 @ 12	0.084 @ 12	0.042 @ 12	1.448 @ 12	0.139 @ 12	0.069 @ 12
1	dry	t+20 conf	611	1.104 @ 10	0.134 @ 10	0.067 @ 10	0.749 @ 11	0.066 @ 11	0.033 @ 11	1.237 @ 11	0.109 @ 11	0.055 @ 11
2	dry	t-0 conf	1024	1.922 @ 9	1.138 @ 8	0.728 @ 7	0.153 @ 2	0.064 @ 3	0.033 @ 3	0.254 @ 2	0.107 @ 3	0.056 @ 3
2	dry	t+4 conf	923	2.377 @ 8	1.515 @ 7	1.051 @ 6	0.208 @ 2	0.100 @ 3	0.053 @ 3	0.346 @ 2	0.168 @ 2	0.088 @ 3
2	dry	t+8 conf	724	3.050 @ 6	2.516 @ 5	2.091 @ 5	0.503 @ 2	0.291 @ 3	0.159 @ 3	0.835 @ 2	0.489 @ 2	0.267 @ 3
2	dry	t+12 conf	460	1.725 @ 1	1.714 @ 1	1.685 @ 1	2.141 @ 2	1.244 @ 2	0.667 @ 3	3.560 @ 2	2.068 @ 2	1.124 @ 3
2	dry	t+16 conf	414	1.901 @ 1	1.888 @ 1	1.854 @ 1	2.178 @ 2	1.273 @ 2	0.663 @ 2	3.625 @ 2	2.120 @ 2	1.111 @ 3
2	dry	t+20 conf	368	1.879 @ 1	1.865 @ 1	1.829 @ 1	1.999 @ 2	1.165 @ 2	0.606 @ 2	3.335 @ 2	1.944 @ 2	1.011 @ 2
3	dry	t-0 conf	448	10.546 @ 5	1.955 @ 5	0.977 @ 5	1.349 @ 2	0.103 @ 2	0.052 @ 2	2.240 @ 2	0.172 @ 2	0.086 @ 2
3	dry	t+4 conf	370	16.349 @ 4	2.852 @ 4	1.426 @ 4	2.518 @ 2	0.240 @ 2	0.120 @ 2	4.180 @ 2	0.399 @ 2	0.199 @ 2
3	dry	t+8 conf	302	21.088 @ 3	3.325 @ 3	1.663 @ 3	4.777 @ 2	0.550 @ 2	0.275 @ 2	7.919 @ 2	0.911 @ 2	0.456 @ 2
3	dry	t+12 conf	265	12.751 @ 3	1.990 @ 3	0.995 @ 3	3.842 @ 2	0.490 @ 2	0.245 @ 2	6.352 @ 2	0.810 @ 2	0.405 @ 2
3	dry	t+16 conf	255	9.939 @ 3	1.512 @ 3	0.756 @ 3	3.151 @ 2	0.404 @ 2	0.202 @ 2	5.206 @ 2	0.668 @ 2	0.334 @ 2
3	dry	t+20 conf	245	7.529 @ 3	1.100 @ 3	0.550 @ 3	2.407 @ 2	0.305 @ 2	0.153 @ 2	3.774 @ 2	0.504 @ 2	0.252 @ 2
1	dry	defl	1091	0.050 @ 8	0.002 @ 9	0.001 @ 9	0.109 @ 7	0.004 @ 8	0.002 @ 8	0.157 @ 7	0.007 @ 8	0.003 @ 8
2	dry	defl	1223	0.020 @ 10	0.007 @ 12	0.004 @ 12	0	0	0	0	0	0
3	dry	defl	1242	0.003 @ 19	0.001 @ 25	0.001 @ 25	0	0	0	0	0	0
1	dry	normal	1000	1.642 @ 8	0.071 @ 9	0.036 @ 9	1.151 @ 8	0.041 @ 9	0.021 @ 9	0.853 @ 8	0.030 @ 9	0.015 @ 9
2	dry	normal	964	1.237 @ 9	0.377 @ 9	0.197 @ 9	0	0	0	0	0	0
3	dry	normal	721	0.960 @ 10	0.107 @ 13	0.053 @ 13	0	0	0	0	0	0
1	wet	normal	976	1.779 @ 9	0.077 @ 10	0.039 @ 10	1.270 @ 9	0.045 @ 10	0.023 @ 10	0.750 @ 9	0.027 @ 10	0.013 @ 10
2	wet	normal	697	2.934 @ 5	1.817 @ 5	1.032 @ 5	0.001 @ 2	0.003 @ 2	0.002 @ 2	0.004 @ 2	0.002 @ 2	0.001 @ 2
3	wet	normal	312	13.499 @ 3	0.722 @ 4	0.361 @ 4	0	0	0	0	0	0
2m	dry	t-0 conf	1014	2.277@9	0.642@10	0.321@10	0.366@2	0.056@3	0.028@3	0.606@2	0.092@3	0.046@3
2m	dry	t+4 conf	914	2.784@8	0.796@6	0.398@6	0.394@3	0.081@3	0.041@3	0.656@6	0.135@3	0.067@3
2m	dry	t+8 conf	715	4.103@5	1.208@5	0.604@5	0.859@3	0.230@3	0.115@3	1.429@3	0.382@3	0.191@3
2m	dry	t+12 conf	456	6.796@3	2.074@3	1.037@3	3.202@3	0.908@3	0.454@3	5.327@3	1.510@3	0.755@3
2m	dry	t+16 conf	401	6.227@3	1.936@3	0.968@3	3.399@3	0.958@3	0.479@3	5.660@3	1.596@3	0.798@3
2m	dry	t+20 conf	361	5.032@2	1.522@3	0.761@3	2.863@3	0.796@3	0.398@3	4.773@3	1.327@3	0.663@3
2m	dry	defl	1252	0.023@12	0.005@15	0.002@15	0	0	0	0	0	0
2m	dry	normal	1008	1.210@9	0.189@11	0.094@11	0	0	0	0	0	0
2m	wet	normal	756	2.729@6	0.314@7	0.157@7	0	0	0	0	0	0

Met Case	Database	Mode	Stab. Hgt. [m]	NO_2 Peak Conc. [ppm]	NO_2 30 Min TWA [ppm]	NO_2 60 Min TWA [ppm]	RP-1 gas Peak Conc. [ppm]	RP-1 gas 30 Min TWA [ppm]	RP-1 gas 60 Min TWA [ppm]	NH_3 Peak Conc. [ppm]	NH_3 30 Min TWA [ppm]	NH_3 60 Min TWA [ppm]	N_2H_4 Peak Conc. [ppm]	N_2H_4 30 Min TWA [ppm]	N_2H_4 60 Min TWA [ppm]
1	dry	t-0 conf	994	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+4 conf	979	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+8 conf	964	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+12 conf	778	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+16 conf	707	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+20 conf	611	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t-0 conf	1024	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+4 conf	923	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+8 conf	724	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+12 conf	460	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+16 conf	414	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+20 conf	368	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t-0 conf	448	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+4 conf	370	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+8 conf	302	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+12 conf	265	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+16 conf	255	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+20 conf	245	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	defl	1091	0	0	0	0	0	0	0.014 @ 8	0.001 @ 8	0	0.013 @ 7	0	0
2	dry	defl	1223	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	defl	1242	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	normal	1000	0	0	0	0	0	0	0.001 @ 8	0	0	0	0	0
2	dry	normal	964	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	normal	721	0	0	0	0	0	0	0	0	0	0	0	0
1	wet	normal	976	0	0	0	0	0	0	0.001 @ 9	0	0	0	0	0
2	wet	normal	697	0	0	0	0	0	0	0	0	0	0	0	0
3	wet	normal	312	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t-0 conf	1014	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+4 conf	914	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+8 conf	715	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+12 conf	456	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+16 conf	401	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	t+20 conf	361	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	defl	1252	0	0	0	0	0	0	0	0	0	0	0	0
2m	dry	normal	1008	0	0	0	0	0	0	0	0	0	0	0	0
2m	wet	normal	756	0	0	0	0	0	0	0	0	0	0	0	0

REEDM Version 7.09 Analysis Results for Delta IV M+4 Vandenberg Cases - Rain Washout Deposition

Met Case	Database	Mode	Stab. Hgt. [m]	Al2O3 0.05 in/hr [mg/m²]	Al2O3 0.10 in/hr [mg/m²]	HCL 0.05 in/hr [pH]	HCL 0.10 in/hr [pH]
1	dry	normal	1000	530 @ 2	799 @ 2	0.247 @ 2	0.370 @ 2
2	dry	normal	964	2119 @ 1	3180 @ 1	0.172 @ 1	0.297 @ 1
3	dry	normal	721	1411 @ 2	2124 @ 2	0.096 @ 2	0.220 @ 2
1	wet	normal	976	580 @ 3	875 @ 3	0.207 @ 3	0.329 @ 3
2	wet	normal	697	2795 @ 1	4198 @ 1	~0.1@ 1	0.142 @ 1
3	wet	normal	312	2559 @ 1	3853 @ 1	~0.1@ 1	~0.1@ 1
1	dry	t-0 conf	994	556 @ 4	831 @ 4	1.087 @ 4	1.213 @ 4
2	dry	t-0 conf	1024	2594 @ 1	3849 @ 1	0.670 @ 1	0.800 @ 1
3	dry	t-0 conf	448	2830 @ 1	4230 @ 1	0.404 @ 1	0.531 @ 1
4	dry	normal	1008	2243@1	3368@1	~0.2@ 1	~0.3@ 1
4	wet	normal	756	2863@1	4300@1	~0.2@ 1	~0.3@ 1
4	dry	t-0 conf	1014	2551@1	3786@1	0.672@1	0.801@1

REEDM Version 7.09 Analysis Results for Atlas V 551/552 Cape Canaveral Cases - Gaseous Concentrations

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 Peak Conc. [mg/m^3]	Al_2O_3 30 Min TWA [mg/m^3]	Al_2O_3 60 Min TWA [mg/m^3]	HCl Peak Conc. [ppm]	HCl 30 Min TWA [ppm]	HCl 60 Min TWA [ppm]	CO Peak Conc. [ppm]	CO 30 Min TWA [ppm]	CO 60 Min TWA [ppm]	NO_2 Peak Conc. [ppm]	NO_2 30 Min TWA [ppm]	NO_2 60 Min TWA [ppm]	RP-1 gas Peak Conc. [ppm]	RP-1 gas 30 Min TWA [ppm]	RP-1 gas 60 Min TWA [ppm]	HH_3 Peak Conc. [ppm]	HH_3 30 Min TWA [ppm]	HH_3 60 Min TWA [ppm]	N_2H_4 Peak Conc. [ppm]	N_2H_4 30 Min TWA [ppm]	N_2H_4 60 Min TWA [ppm]
1	dry	t-0 conf.	1287	0.695 @ 25	0.187 @ 25	0.094 @ 25	0.306 @ 15	0.092 @ 30	0.046 @ 18	0.046 @ 15	0.014 @ 18	0.007 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+6 conf.	1125	0.780 @ 20	0.235 @ 21	0.118 @ 21	0.540 @ 15	0.162 @ 18	0.081 @ 18	0.081 @ 15	0.024 @ 18	0.012 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+12 conf.	1009	0.422 @ 19	0.137 @ 21	0.068 @ 21	0.365 @ 16	0.113 @ 19	0.057 @ 19	0.055 @ 16	0.017 @ 19	0.009 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+18 conf.	865	0.322 @ 17	0.097 @ 20	0.049 @ 20	0.343 @ 16	0.102 @ 19	0.051 @ 19	0.052 @ 16	0.015 @ 19	0.008 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+24 conf.	842	0.181 @ 11	0.051 @ 20	0.025 @ 20	0.200 @ 16	0.056 @ 19	0.028 @ 19	0.030 @ 16	0.008 @ 19	0.004 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+30 conf.	842	0.066 @ 11	-0.017 @ 19	0.008 @ 19	0.071 @ 16	0.019 @ 19	0.009 @ 19	0.011 @ 16	0.003 @ 19	0.001 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t-0 conf.	1816	0.192 @ 25	0.076 @ 30	0.038 @ 31	0.206 @ 24	0.082 @ 30	0.041 @ 30	0.031 @ 24	0.012 @ 30	0.006 @ 30	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+6 conf.	1627	0.257 @ 24	0.096 @ 30	0.048 @ 30	0.286 @ 24	0.111 @ 30	0.056 @ 30	0.043 @ 24	0.017 @ 30	0.008 @ 30	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+12 conf.	275	18.321 @ 4	2.318 @ 4	1.159 @ 4	9.905 @ 5	1.059 @ 5	0.530 @ 5	1.490 @ 5	0.159 @ 5	0.080 @ 5	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+18 conf.	198	15.959 @ 3	2.454 @ 3	1.227 @ 3	9.372 @ 4	0.974 @ 4	0.487 @ 4	1.412 @ 4	0.147 @ 4	0.073 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+24 conf.	190	10.614 @ 3	1.423 @ 3	0.712 @ 3	6.110 @ 4	0.550 @ 4	0.275 @ 4	0.921 @ 4	0.083 @ 4	0.041 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+30 conf.	194	4.421 @ 3	0.483 @ 3	0.241 @ 3	2.559 @ 3	0.185 @ 4	0.093 @ 4	0.384 @ 3	0.028 @ 4	0.014 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t-0 conf.	1880	0.849 @ 32	0.157 @ 37	0.078 @ 37	0.301 @ 24	0.050 @ 27	0.025 @ 27	0.045 @ 24	0.007 @ 27	0.004 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+6 conf.	1697	1.066 @ 29	0.196 @ 32	0.098 @ 32	0.435 @ 25	0.076 @ 28	0.038 @ 28	0.065 @ 25	0.011 @ 28	0.006 @ 28	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+12 conf.	1492	0.721 @ 27	0.136 @ 29	0.068 @ 29	0.376 @ 26	0.069 @ 29	0.035 @ 29	0.057 @ 26	0.010 @ 29	0.005 @ 29	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+18 conf.	1214	0.574 @ 25	0.104 @ 27	0.052 @ 27	0.339 @ 25	0.059 @ 27	0.030 @ 27	0.051 @ 25	0.009 @ 27	0.004 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+24 conf.	1194	0.329 @ 25	0.055 @ 27	0.027 @ 27	0.196 @ 25	0.032 @ 28	0.016 @ 28	0.030 @ 25	0.005 @ 28	0.002 @ 28	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+30 conf.	1188	0.124 @ 24	0.018 @ 27	0.009 @ 27	0.075 @ 24	0.011 @ 28	0.005 @ 28	0.011 @ 25	0.002 @ 28	0.001 @ 28	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t-0 conf.	1927	0.052 @ 36	0.027 @ 40	0.014 @ 40	0.032 @ 2	0.002 @ 2	0.001 @ 2	0.005 @ 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+6 conf.	1667	0.102 @ 31	0.048 @ 40	0.025 @ 40	0.016 @ 2	0.001 @ 7	0.001 @ 7	0.002 @ 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+12 conf.	273	19.823 @ 6	2.455 @ 6	1.228 @ 6	12.776 @ 6	1.562 @ 6	0.781 @ 6	1.929 @ 6	0.236 @ 6	0.118 @ 6	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+18 conf.	167	19.623 @ 3	2.514 @ 3	1.257 @ 3	13.776 @ 4	1.594 @ 4	0.797 @ 4	2.041 @ 4	0.241 @ 4	0.121 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+24 conf.	160	12.833 @ 3	1.440 @ 3	0.721 @ 3	8.626 @ 4	0.891 @ 4	0.445 @ 4	1.306 @ 4	0.135 @ 4	0.067 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+30 conf.	164	5.279 @ 3	0.489 @ 3	0.244 @ 3	3.594 @ 4	0.308 @ 4	0.154 @ 4	0.544 @ 4	0.047 @ 4	0.023 @ 4	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t-0 defl	1055	0.018 @ 17	0.004 @ 17	0.002 @ 19	0.041 @ 14	0.041 @ 14	0.005 @ 18	1.607 @ 14	0.397 @ 18	0.198 @ 18	0	0	0	0.056 @ 14	0.014 @ 18	0.007 @ 18	0.005 @ 14	0.001 @ 18	0.001 @ 18	0	0	0
2	dry	t-0 defl	1509	0.005 @ 21	0.001 @ 28	0.001 @ 28	0.022 @ 23	0.022 @ 23	0.004 @ 30	0.861 @ 23	0.263 @ 30	0.142 @ 30	0	0	0	0.031 @ 23	0.010 @ 30	0.005 @ 30	0.003 @ 23	0.001 @ 23	0	0	0	0
3	dry	t-0 defl	1441	0.44 @ 25	0.004 @ 27	0.004 @ 27	0.077 @ 22	0.077 @ 22	0.004 @ 27	3.020 @ 22	0.314 @ 27	0.157 @ 27	0	0	0	0.109 @ 22	0.011 @ 27	0.006 @ 27	0.010 @ 22	0.001 @ 27	0.001 @ 27	0.001 @ 22	0	0
4	dry	t-0 defl	1682	0.002 @ 38	0.001 @ 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	normal	1080	0.389 @ 19	0.070 @ 20	0.035 @ 20	0.213 @ 14	0.052 @ 18	0.026 @ 18	0.199 @ 14	0.049 @ 18	0.025 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	normal	1608	0.117 @ 24	0.034 @ 30	0.017 @ 30	0.134 @ 24	0.045 @ 30	0.023 @ 30	0.125 @ 24	0.043 @ 30	0.021 @ 30	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	normal	1495	1.051 @ 28	0.089 @ 29	0.045 @ 29	0.466 @ 22	0.047 @ 26	0.024 @ 26	0.436 @ 22	0.044 @ 27	0.022 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	normal	1775	0.021 @ 40	0.010 @ 40	0.005 @ 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	wet	normal	1049	0.404 @ 18	0.074 @ 20	0.037 @ 20	0.244 @ 15	0.059 @ 18	0.030 @ 18	0.174 @ 15	0.042 @ 18	0.021 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
2	wet	normal	1501	0.130 @ 23	0.036 @ 29	0.018 @ 30	0.161 @ 24	0.053 @ 30	0.026 @ 30	0.122 @ 24	0.040 @ 30	0.020 @ 30	0	0	0	0	0	0	0	0	0	0	0	0
3	wet	normal	1496	0.998 @ 29	0.084 @ 30	0.042 @ 30	0.443 @ 23	0.045 @ 27	0.022 @ 27	0.330 @ 23	0.033 @ 27	0.017 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
4	wet	normal	1686	0.037 @ 39	0.013 @ 40	0.006 @ 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

REEDM Version 7:09 Analysis Results for Atlas V 551/552 Cape Canaveral Cases - Rain Washout Deposition

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 0.1 in/hr [mg/m^2]	Al_2O_3 0.3 in/hr [mg/m^2]	HCl 0.1 in/hr [pH]	HCl 0.3 in/hr [pH]
1	dry	normal	1080	1990 @ 1	3790 @ 1	0.222 @ 1	0.419 @ 1
2	dry	normal	1608	3891 @ 2	7265 @ 2	0.364 @ 2	0.568 @ 2
3	dry	normal	1495	1965 @ 2	3731 @ 2	0.311 @ 2	0.508 @ 2
4	dry	normal	1775	2282 @ 2	4279 @ 2	0.532 @ 2	0.734 @ 2
1	wet	normal	1049	2067 @ 1	3942 @ 1	0.158 @ 1	0.355 @ 1
2	wet	normal	1505	2784 @ 3	5216 @ 3	0.531 @ 3	0.735 @ 3
3	wet	normal	1495	1703 @ 4	3232 @ 4	0.383 @ 4	0.580 @ 4
4	wet	normal	1686	2120 @ 3	3989 @ 3	0.498 @ 3	0.696 @ 3
1	dry	t-0 conf	1287	2565 @ 2	4737 @ 2	0.893 @ 2	1.104 @ 2
2	dry	t-0 conf	1816	4684 @ 2	8181 @ 2	0.968 @ 2	1.199 @ 2
3	dry	t-0 conf	1881	2380 @ 4	4356 @ 4	1.011 @ 4	1.226 @ 4
4	dry	t-0 conf	1927	3065 @ 3	5512 @ 3	1.038 @ 3	1.260 @ 3

REEDM Version 7.09 Analysis Results for Delta IV M+4 Cape Canaveral Cases - Gaseous Concentrations

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 Peak Conc. [mg/m³]	Al_2O_3 30 Min TWA [mg/m³]	Al_2O_3 60 Min TWA [mg/m³]	HCl Peak Conc. [ppm]	HCl 30 Min TWA [ppm]	HCl 60 Min TWA [ppm]	CO Peak Conc. [ppm]	CO 30 Min TWA [ppm]	CO 60 Min TWA [ppm]	NO_2 Peak Conc. [ppm]	NO_2 30 Min TWA [ppm]	NO_2 60 Min TWA [ppm]	RP-1 gas Peak Conc. [ppm]	RP-1 gas 30 Min TWA [ppm]	RP-1 gas 60 Min TWA [ppm]	HH_3 Peak Conc. [ppm]	HH_3 30 Min TWA [ppm]	HH_3 60 Min TWA [ppm]	N_2H_4 Peak Conc. [ppm]	N_2H_4 30 Min TWA [ppm]	N_2H_4 60 Min TWA [ppm]
1	dry	t-0 conf.	1047	0.494 @ 18	0.145 @ 20	0.072 @ 20	0.410 @ 15	0.119 @ 18	0.059 @ 18	0.660 @ 15	0.197 @ 18	0.099 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+4 conf.	1037	0.486 @ 19	0.144 @ 20	0.072 @ 20	0.413 @ 15	0.120 @ 18	0.060 @ 18	0.683 @ 15	0.199 @ 18	0.100 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+8 conf.	1015	0.430 @ 19	0.131 @ 21	0.065 @ 21	0.374 @ 16	0.111 @ 19	0.055 @ 19	0.620 @ 16	0.184 @ 19	0.092 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+12 conf.	762	0.445 @ 10	0.076 @ 18	0.038 @ 19	0.387 @ 15	0.101 @ 18	0.050 @ 18	0.642 @ 15	0.168 @ 18	0.084 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+16 conf.	721	0.401 @ 11	0.062 @ 16	0.031 @ 16	0.315 @ 15	0.077 @ 18	0.039 @ 18	0.523 @ 15	0.129 @ 18	0.064 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t+20 conf.	618	0.545 @ 11	0.067 @ 12	0.034 @ 12	0.314 @ 13	0.065 @ 15	0.033 @ 15	0.521 @ 13	0.108 @ 15	0.054 @ 15	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t-0 conf.	1016	1.038 @ 12	0.169 @ 14	0.085 @ 14	0.578 @ 15	0.141 @ 18	0.071 @ 18	0.956 @ 15	0.235 @ 18	0.117 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+4 conf.	749	2.761 @ 9	0.360 @ 10	0.180 @ 10	1.477 @ 11	0.254 @ 13	0.127 @ 13	2.445 @ 11	0.421 @ 13	0.211 @ 13	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+8 conf.	348	14.599 @ 5	1.658 @ 5	0.829 @ 5	9.571 @ 5	0.868 @ 5	0.434 @ 5	15.830 @ 5	1.436 @ 5	0.718 @ 5	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+12 conf.	174	23.502 @ 3	3.129 @ 3	1.564 @ 3	14.530 @ 3	1.255 @ 3	0.628 @ 3	24.076 @ 3	2.079 @ 3	1.040 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+16 conf.	138	23.539 @ 2	3.197 @ 2	1.599 @ 2	13.591 @ 3	1.169 @ 3	0.584 @ 3	23.205 @ 3	1.944 @ 3	0.972 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	t+20 conf.	108	24.177 @ 2	3.252 @ 2	1.626 @ 2	14.591 @ 2	1.146 @ 2	0.573 @ 2	24.052 @ 2	1.899 @ 2	0.949 @ 2	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t-0 conf.	1492	0.918 @ 26	0.152 @ 29	0.076 @ 29	0.448 @ 24	0.072 @ 27	0.036 @ 27	0.742 @ 24	0.119 @ 27	0.060 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+4 conf.	1464	0.905 @ 27	0.152 @ 29	0.076 @ 29	0.453 @ 25	0.074 @ 28	0.037 @ 28	0.750 @ 25	0.122 @ 28	0.061 @ 28	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+8 conf.	1390	0.822 @ 27	0.141 @ 29	0.071 @ 29	0.434 @ 25	0.072 @ 28	0.036 @ 28	0.718 @ 25	0.120 @ 28	0.060 @ 28	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+12 conf.	946	0.368 @ 19	0.052 @ 21	0.026 @ 21	0.239 @ 21	0.033 @ 23	0.016 @ 23	0.396 @ 21	0.054 @ 23	0.027 @ 23	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+16 conf.	1054	0.446 @ 22	0.070 @ 25	0.035 @ 25	0.282 @ 23	0.042 @ 26	0.021 @ 26	0.468 @ 23	0.070 @ 26	0.035 @ 26	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	t+20 conf.	1104	0.582 @ 23	0.094 @ 25	0.047 @ 25	0.361 @ 24	0.056 @ 27	0.028 @ 27	0.599 @ 24	0.093 @ 27	0.047 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t-0 conf.	1005	1.062 @ 23	0.136 @ 25	0.068 @ 25	0.119 @ 1	0.007 @ 1	0.003 @ 1	0.196 @ 1	0.012 @ 1	0.006 @ 1	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+4 conf.	755	2.480 @ 18	0.269 @ 18	0.135 @ 18	0.224 @ 6	0.018 @ 6	0.009 @ 6	0.372 @ 6	0.030 @ 6	0.015 @ 6	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+8 conf.	384	11.787 @ 7	1.212 @ 7	0.606 @ 7	4.564 @ 6	0.467 @ 6	0.234 @ 6	7.566 @ 6	0.776 @ 6	0.388 @ 6	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+12 conf.	149	28.708 @ 3	3.017 @ 3	1.508 @ 3	20.124 @ 3	1.907 @ 3	0.953 @ 3	33.408 @ 3	3.166 @ 3	1.583 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+16 conf.	120	30.003 @ 2	3.222 @ 2	1.611 @ 2	19.462 @ 3	1.807 @ 3	0.904 @ 3	32.445 @ 3	3.012 @ 3	1.506 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	t+20 conf.	98	28.999 @ 2	3.123 @ 2	1.562 @ 2	16.678 @ 2	1.485 @ 3	0.743 @ 3	27.752 @ 3	2.490 @ 3	1.245 @ 3	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	t-0 defl	1160	0.010 @ 21	0.002 @ 21	0.001 @ 21	0.014 @ 14	0.004 @ 18	0.002 @ 18	0.023 @ 14	0.006 @ 18	0.003 @ 18	0	0	0	0	0	0	0.002 @ 14	0	0	0.002 @ 14	0	0
2	dry	t-0 defl	1661	0.003 @ 24	0.001 @ 29	0	0.009 @ 24	0.003 @ 30	0.002 @ 30	0.015 @ 24	0.005 @ 30	0.003 @ 30	0	0	0	0	0	0	0.001 @ 24	0	0	0.001 @ 23	0	0
3	dry	t-0 defl	1561	0.021 @ 27	0.002 @ 29	0.001 @ 29	0.031 @ 22	0.003 @ 27	0.002 @ 27	0.050 @ 22	0.005 @ 27	0.003 @ 27	0	0	0	0	0	0	0.004 @ 22	0	0	0.003 @ 22	0	0
4	dry	t-0 defl	1839	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	dry	normal	1047	0.255 @ 18	0.046 @ 20	0.023 @ 20	0.156 @ 14	0.038 @ 18	0.019 @ 18	0.116 @ 14	0.028 @ 18	0.014 @ 18	0	0	0	0	0	0	0	0	0	0	0	0
2	dry	normal	1508	0.083 @ 23	0.023 @ 29	0.012 @ 29	0.104 @ 23	0.034 @ 30	0.017 @ 30	0.077 @ 23	0.026 @ 30	0.013 @ 30	0	0	0	0	0	0	0	0	0	0	0	0
3	dry	normal	1494	0.650 @ 29	0.055 @ 30	0.027 @ 30	0.291 @ 23	0.029 @ 27	0.015 @ 27	0.216 @ 23	0.022 @ 27	0.011 @ 27	0	0	0	0	0	0	0	0	0	0	0	0
4	dry	normal	1690	0.023 @ 39	0.008 @ 40	0.004 @ 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	wet	normal	1048	0.252 @ 19	0.046 @ 21	0.023 @ 21	0.153 @ 15	0.037 @ 19	0.019 @ 19	0.092 @ 15	0.022 @ 19	0.011 @ 19	0	0	0	0	0	0	0	0	0	0	0	0
2	wet	normal	1437	0.092 @ 22	0.023 @ 29	0.012 @ 29	0.113 @ 24	0.036 @ 30	0.018 @ 30	0.071 @ 24	0.023 @ 31	0.011 @ 31	0	0	0	0	0	0	0	0	0	0	0	0
3	wet	normal	1190	0.996 @ 23	0.080 @ 25	0.040 @ 25	0.634 @ 21	0.058 @ 26	0.029 @ 21	0.393 @ 21	0.036 @ 26	0.018 @ 26	0	0	0	0	0	0	0	0	0	0	0	0
4	wet	normal	1617	0.035 @ 38	0.009 @ 40	0.005 @ 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

REEDM Version 7.09 Analysis Results for Delta IV M+4 Cape Canaveral Cases - Rain Washout Deposition

Met Case	Database	Mode	Stab. Hgt. [m]	Al_2O_3 0.1 in/hr [mg/m²]	Al_2O_3 0.3 in/hr [mg/m²]	HCl 0.1 in/hr [pH]	HCl 0.3 in/hr [pH]
1	dry	normal	1047	1410 @ 1	2687 @ 1	0.34 @ 1	0.54 @ 1
2	dry	normal	1509	2414 @ 2	4525 @ 2	0.58 @ 2	0.78 @ 2
3	dry	normal	1495	1194 @ 3	2267 @ 3	0.52 @ 3	0.72 @ 3
4	dry	normal	1690	1264 @ 3	2377 @ 3	0.74 @ 3	0.95 @ 3
1	wet	normal	1048	1307 @ 2	2492 @ 2	0.22 @ 2	0.41 @ 2
2	wet	normal	1437	2206 @ 3	4157 @ 3	0.54 @ 3	0.75 @ 3
3	wet	normal	1190	1537 @ 3	2927 @ 3	0.32 @ 3	0.51 @ 3
4	wet	normal	1617	1233 @ 4	2322 @ 4	0.74 @ 4	0.94 @ 4
1	dry	t-0 conf	1047	1248 @ 2	2315 @ 2	1.67 @ 2	1.38 @ 2
2	dry	t-0 conf	1016	2257 @ 3	4173 @ 3	0.94 @ 3	1.16 @ 3
3	dry	t-0 conf	1492	1509 @ 4	2784 @ 4	1.13 @ 4	1.34 @ 4
4	dry	t-0 conf	1005	2567 @ 2	4756 @ 2	0.86 @ 2	1.07 @ 2

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Figures

Figure 1: Peak Downwind Ground Level PM10 from Normal Atlas V Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types; met case 1 is a solid line, 2 is small dashes, 3 is large dashes. For 'wet' launches the fill of the symbol also varies with met case for clarity. The modified version of met case 2 that in this situation is handled more accurately by REEDM was used here. Detailed descriptions of the met cases are given in this appendix.

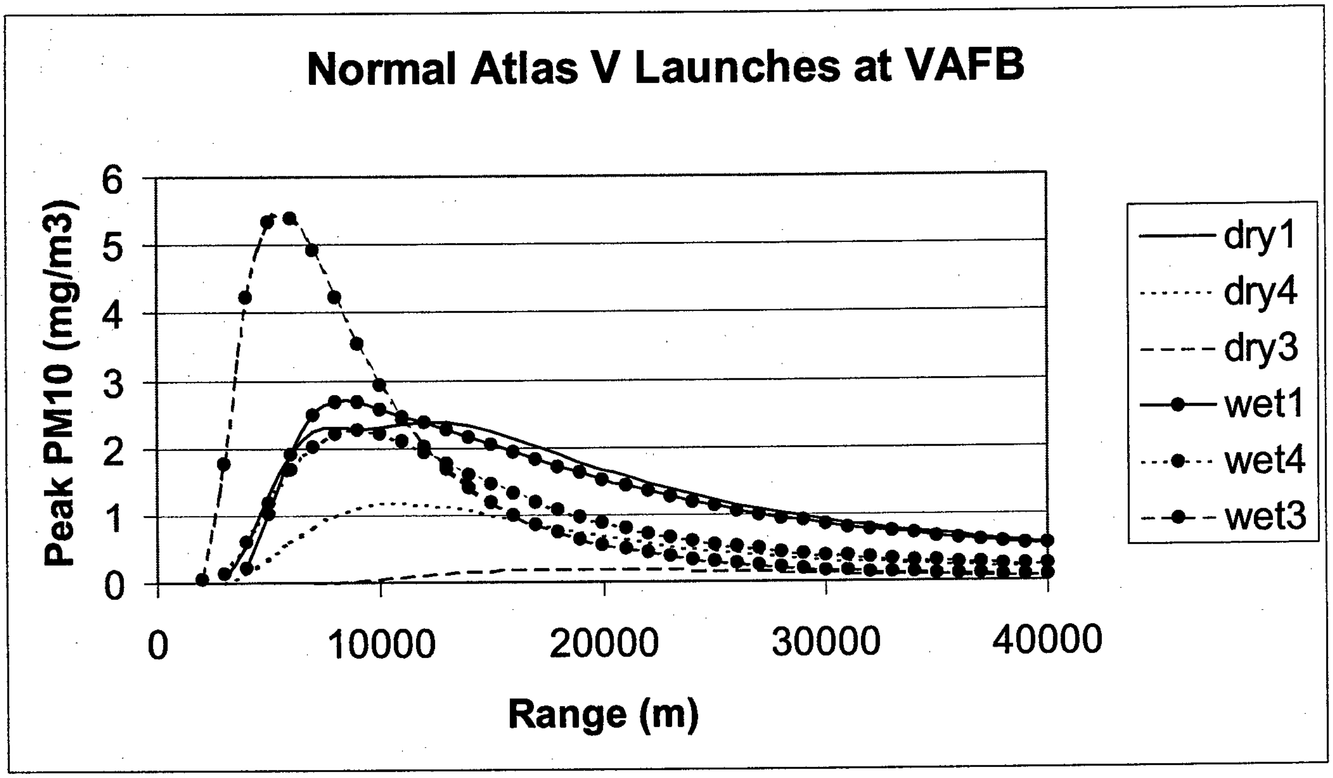


Figure 2: Peak Downwind Ground Level CO from Normal Atlas V Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity. Detailed descriptions of the met cases are given in this appendix.

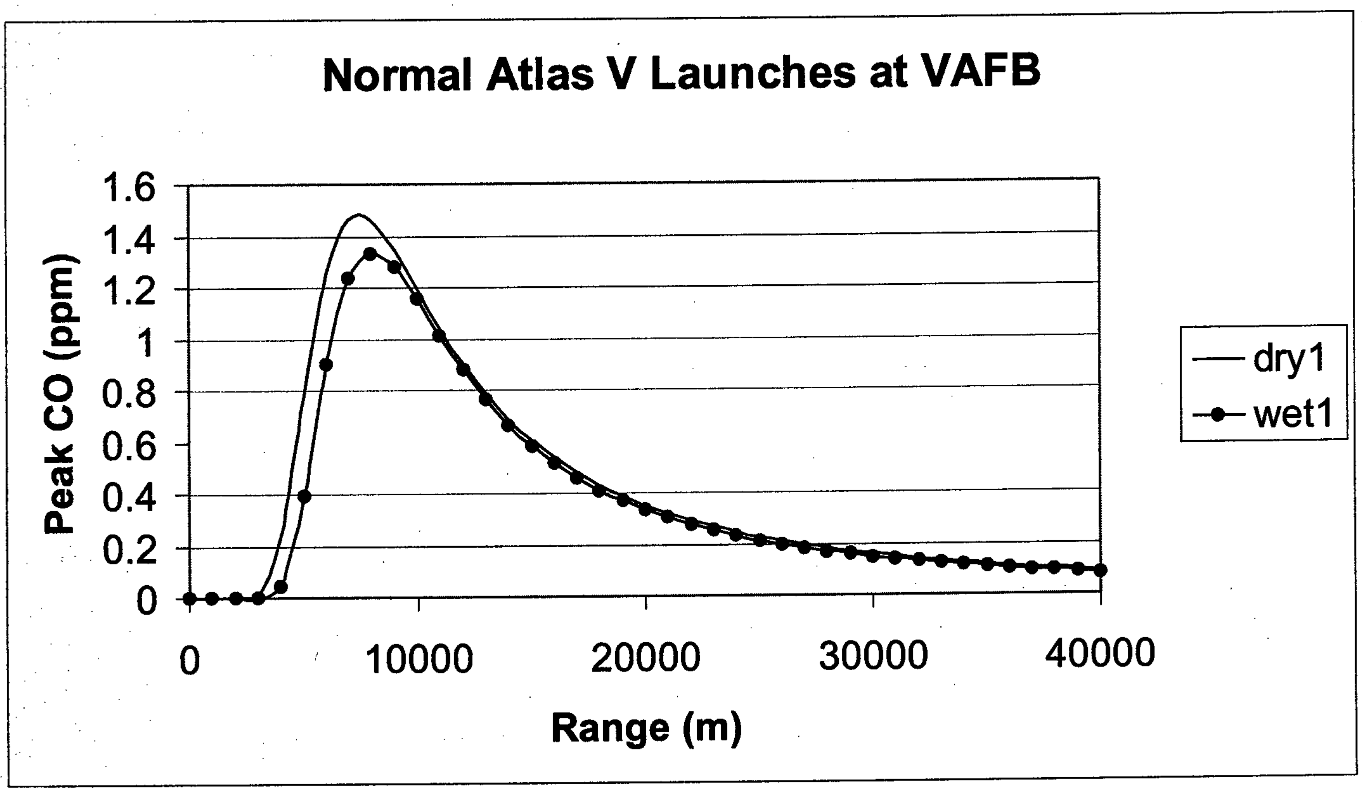


Figure 3: Peak Downwind Ground Level HCl from Normal Atlas V Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity. Detailed descriptions of the met cases are given in this appendix.

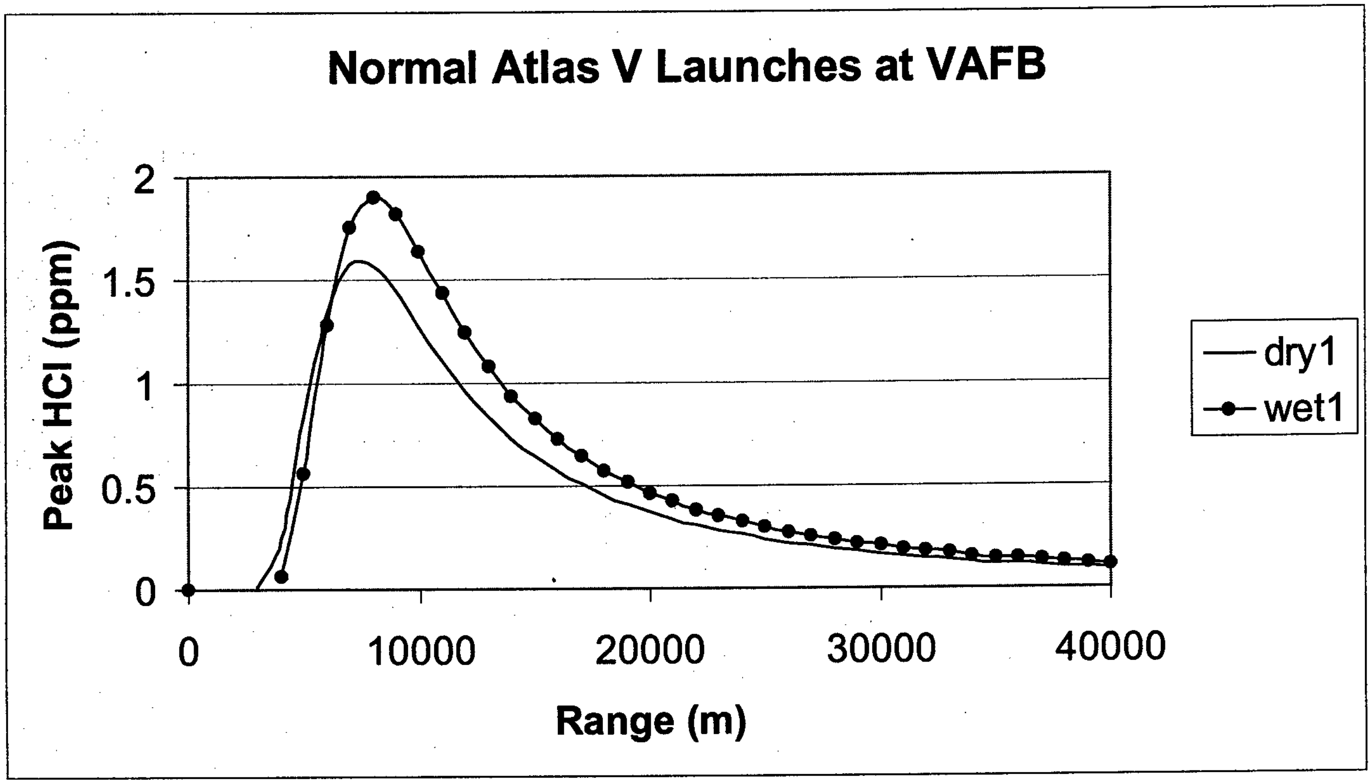


Figure 4: Peak Downwind Ground Level CO from Atlas V Launch Failures at VAFB.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, and 3 is large dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 6 seconds after ignition, t+6, is a line marked with an X, 12 seconds is an asterisk, 18 seconds is a circle, 24 seconds is a triangle, and 30 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Only 1 met case generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

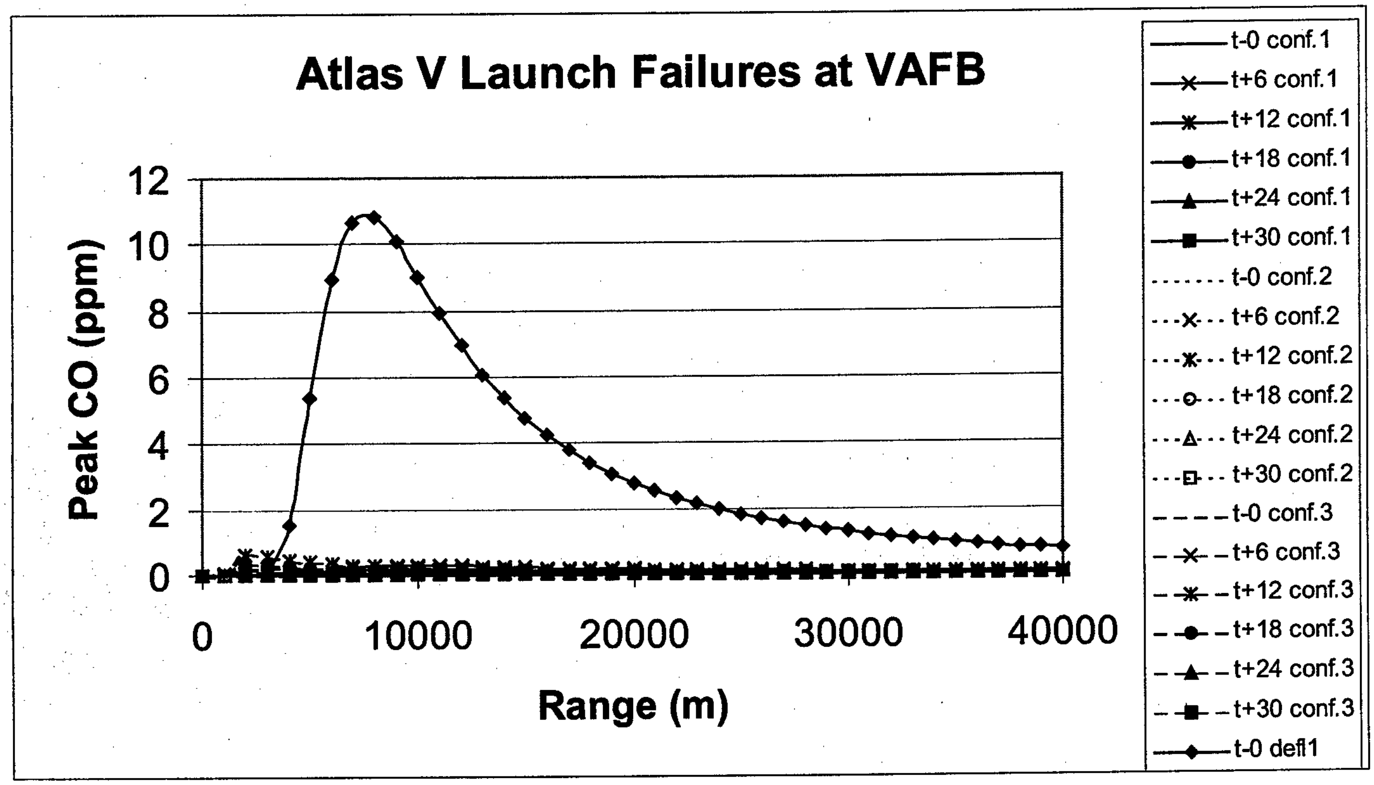


Figure 5: Peak Downwind Ground Level HCl from Atlas V Launch Failures at VAFB.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, and 3 is large dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 6 seconds after ignition, t+6, is a line marked with an X, 12 seconds is an asterisk, 18 seconds is a circle, 24 seconds is a triangle, and 30 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Only 1 met case generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

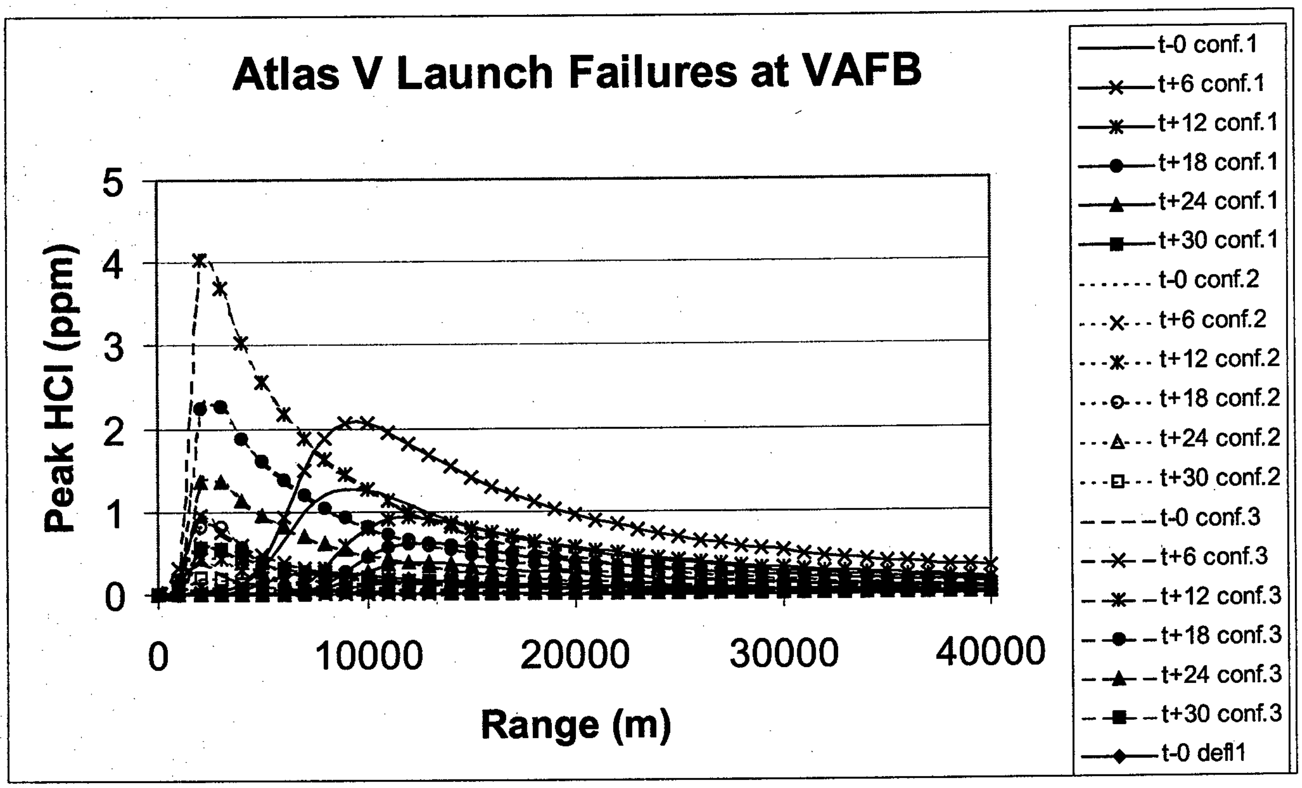


Figure 6: Peak Downwind Ground Level PM10 from Normal Delta IV Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types; met case 1 is a solid line, 2 is small dashes, 3 is large dashes. For 'wet' launches the fill of the symbol also varies with met case for clarity. The modified version of met case 2 that in this situation is handled more accurately by REEDM was used here. Detailed descriptions of the met cases are given in this appendix.

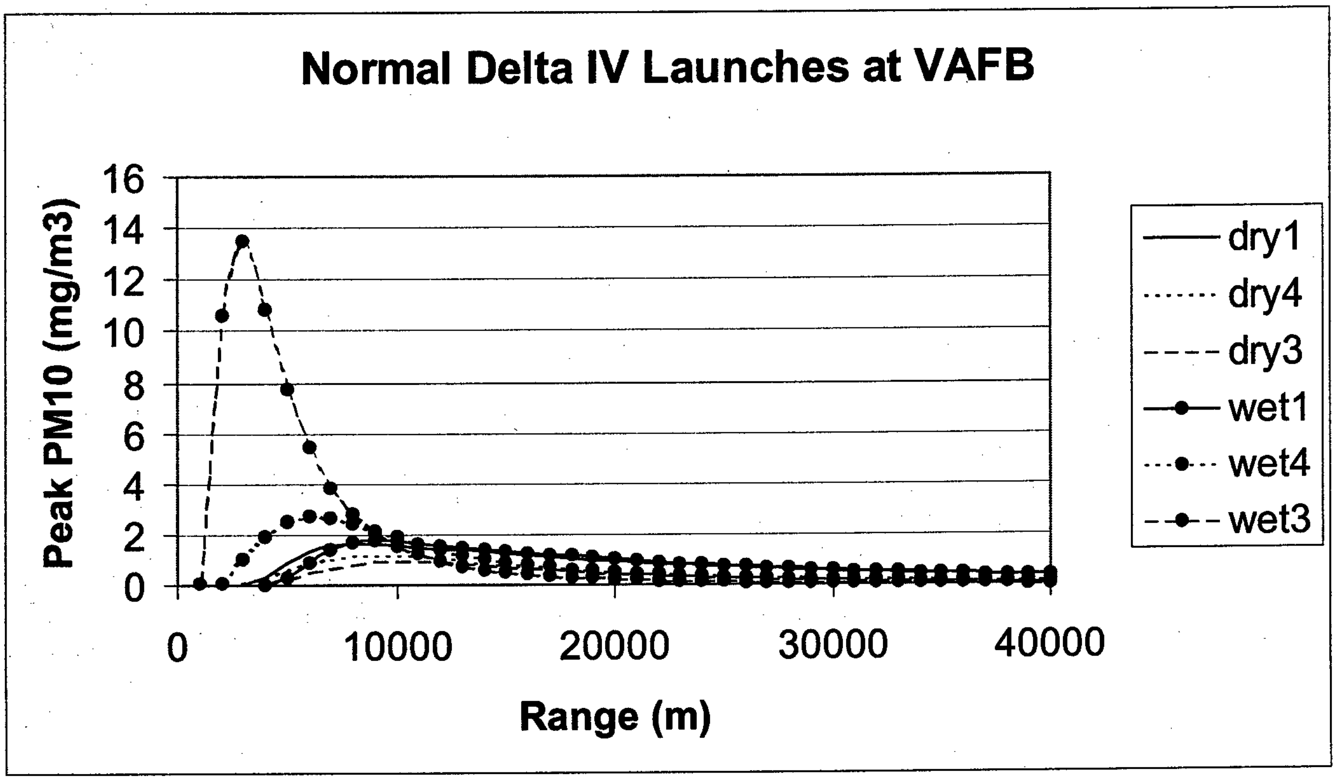


Figure 7: Peak Downwind Ground Level CO from Normal Delta IV Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity. Detailed descriptions of the met cases are given in this appendix.

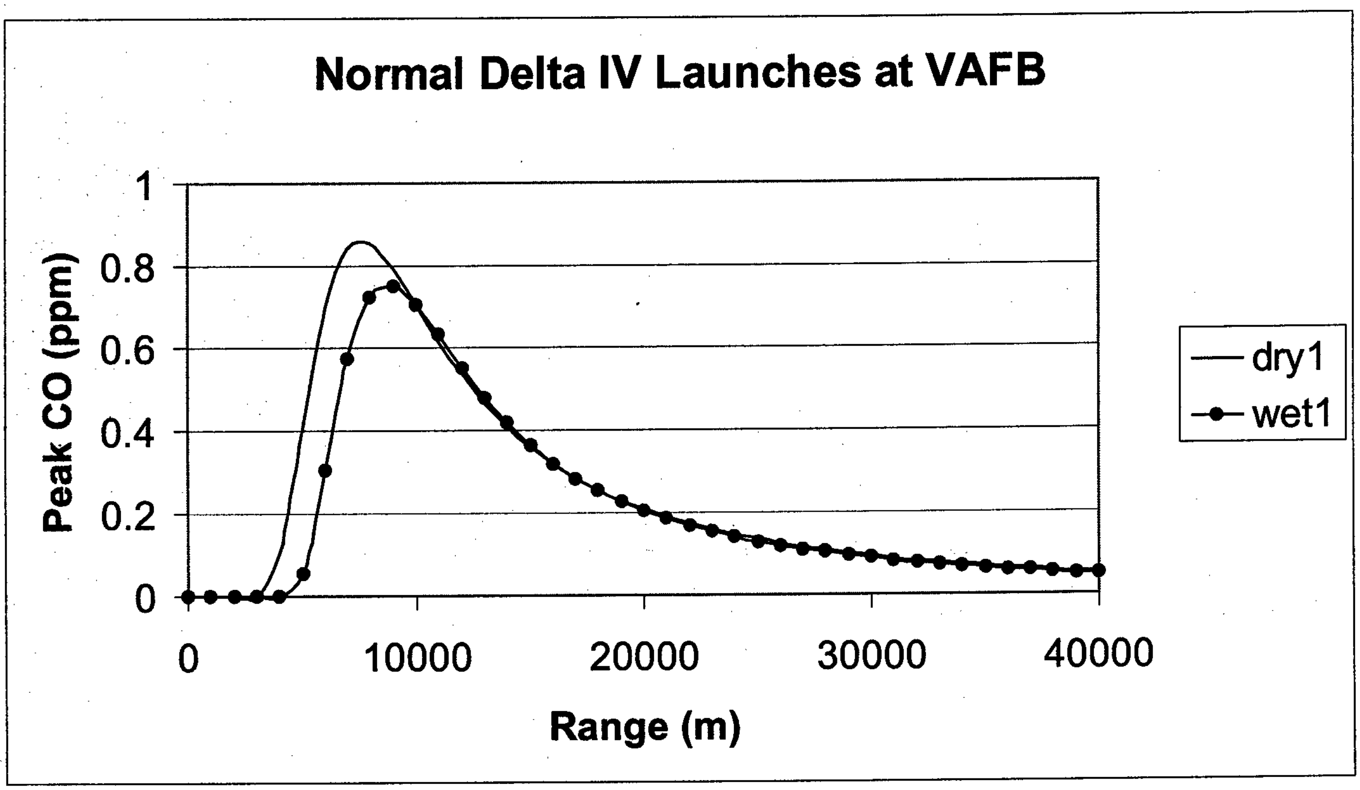


Figure 8: Peak Downwind Ground Level HCl from Normal Delta IV Launches at VAFB.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity. Detailed descriptions of the met cases are given in this appendix.

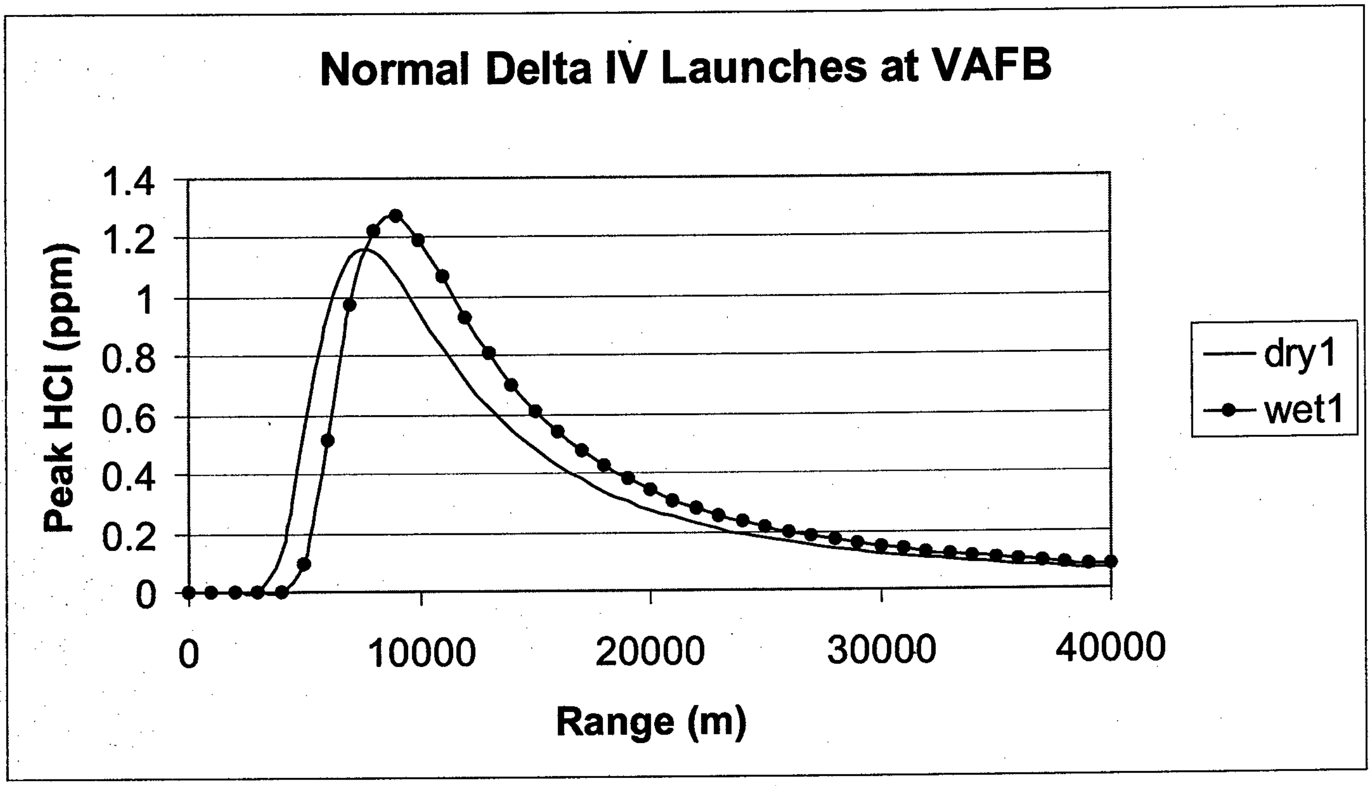


Figure 9: Peak Downwind Ground Level CO from Delta IV Launch Failures at VAFB.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, and 3 is large dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 4 seconds after ignition, t+4, is a line marked with an X, 8 seconds is an asterisk, 12 seconds is a circle, 16 seconds is a triangle, and 20 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Only 1 met case generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

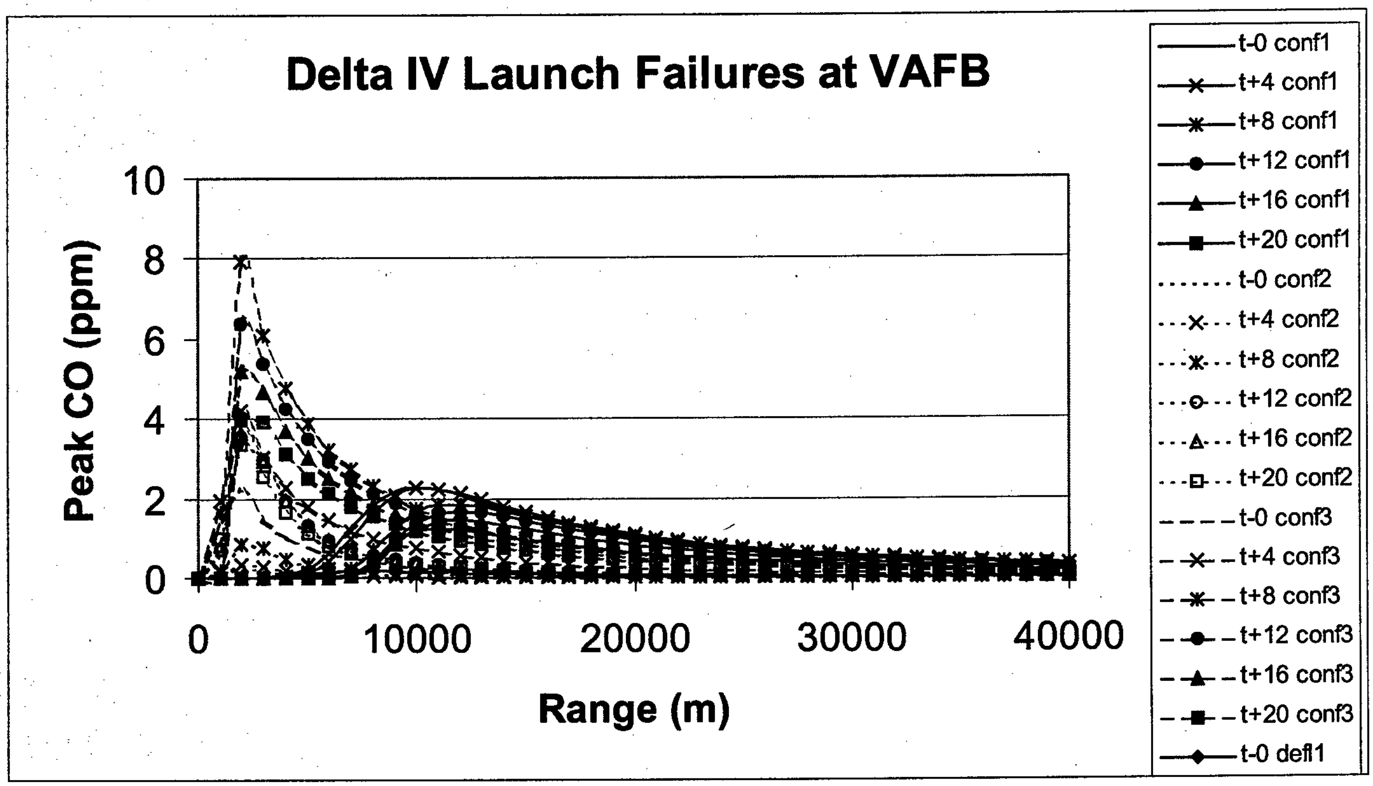


Figure 10: Peak Downwind Ground Level HCl from Delta IV Launch Failures at VAFB.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, and 3 is large dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 4 seconds after ignition, t+4, is a line marked with an X, 8 seconds is an asterisk, 12 seconds is a circle, 16 seconds is a triangle, and 20 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Only 1 met case generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

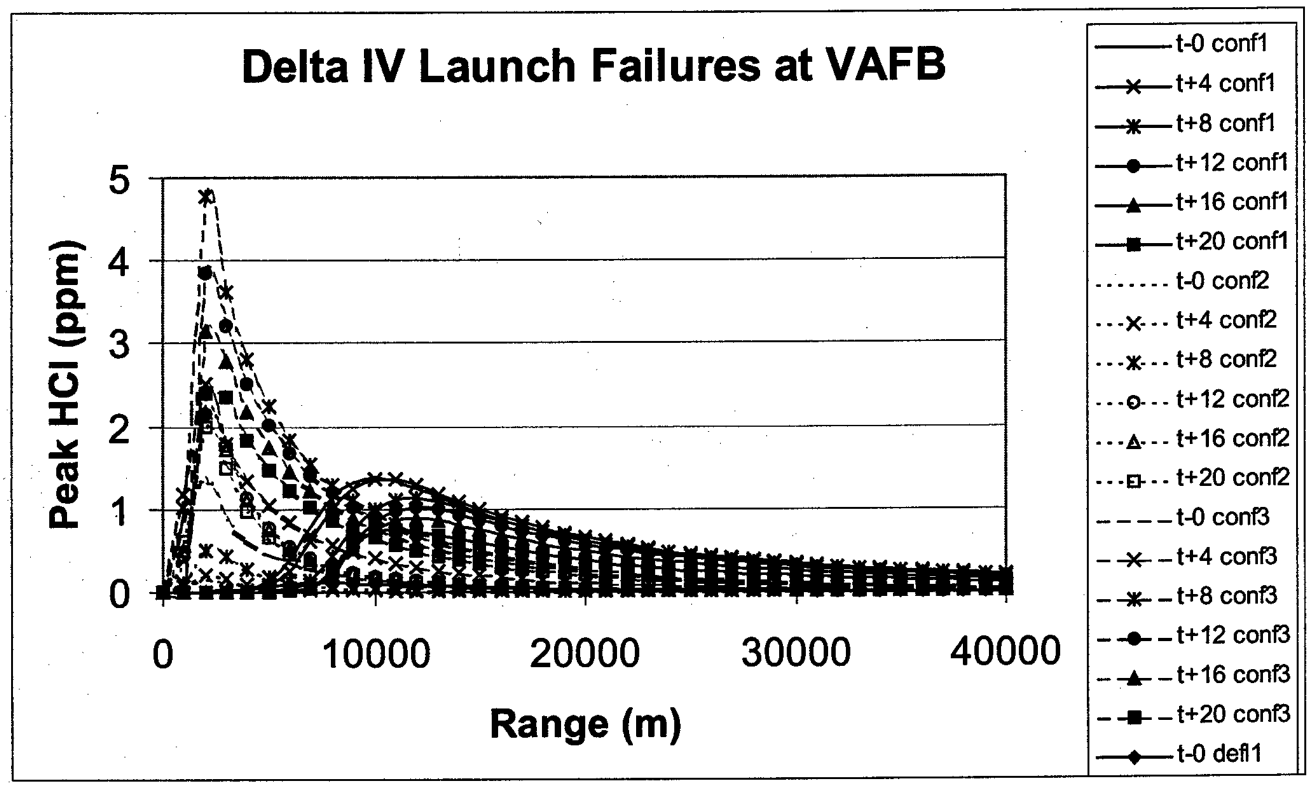


Figure 11: Peak Downwind Ground Level PM10 from Normal Atlas V Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types; met case 1 is a solid line, 2 is small dashes, 3 is large dashes, and 4 is large and small dashes. For 'wet' launches the fill of the symbol also varies with met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

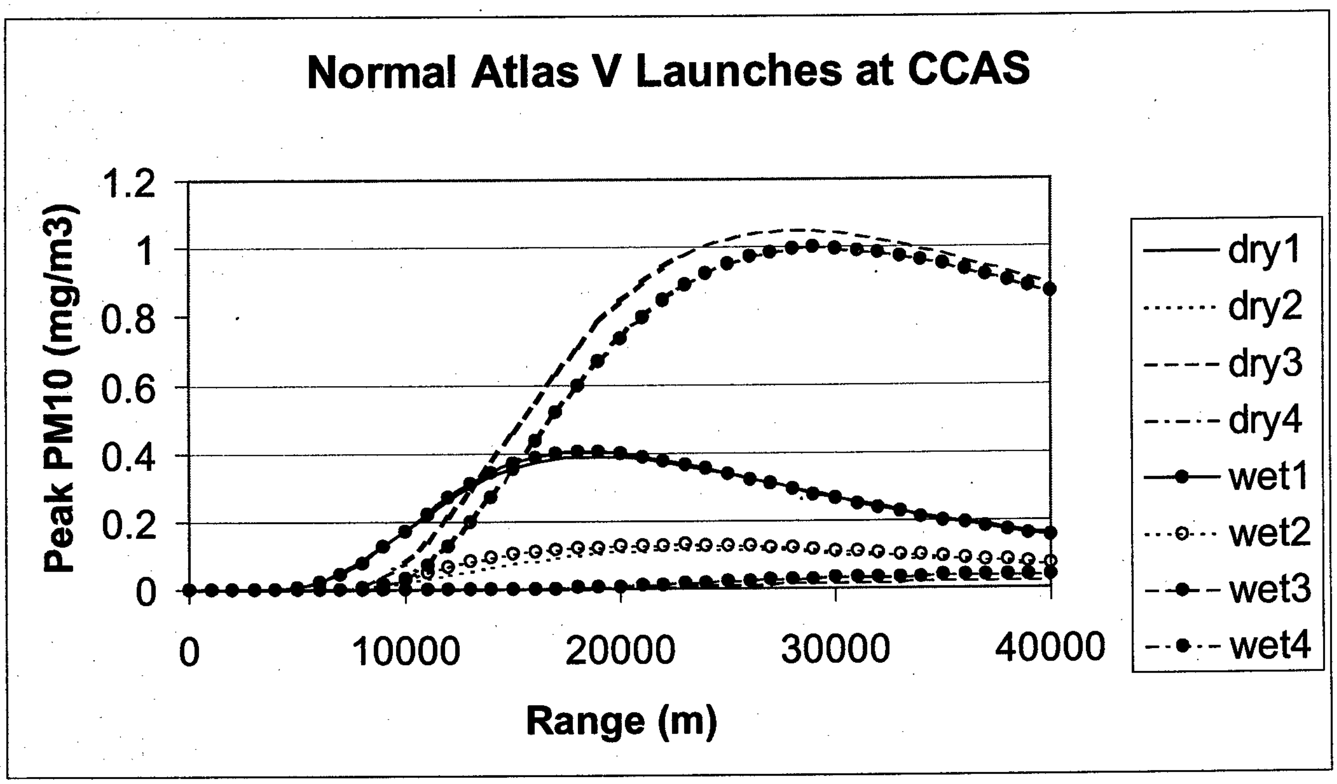


Figure 12: Peak Downwind Ground Level CO from Normal Atlas V Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

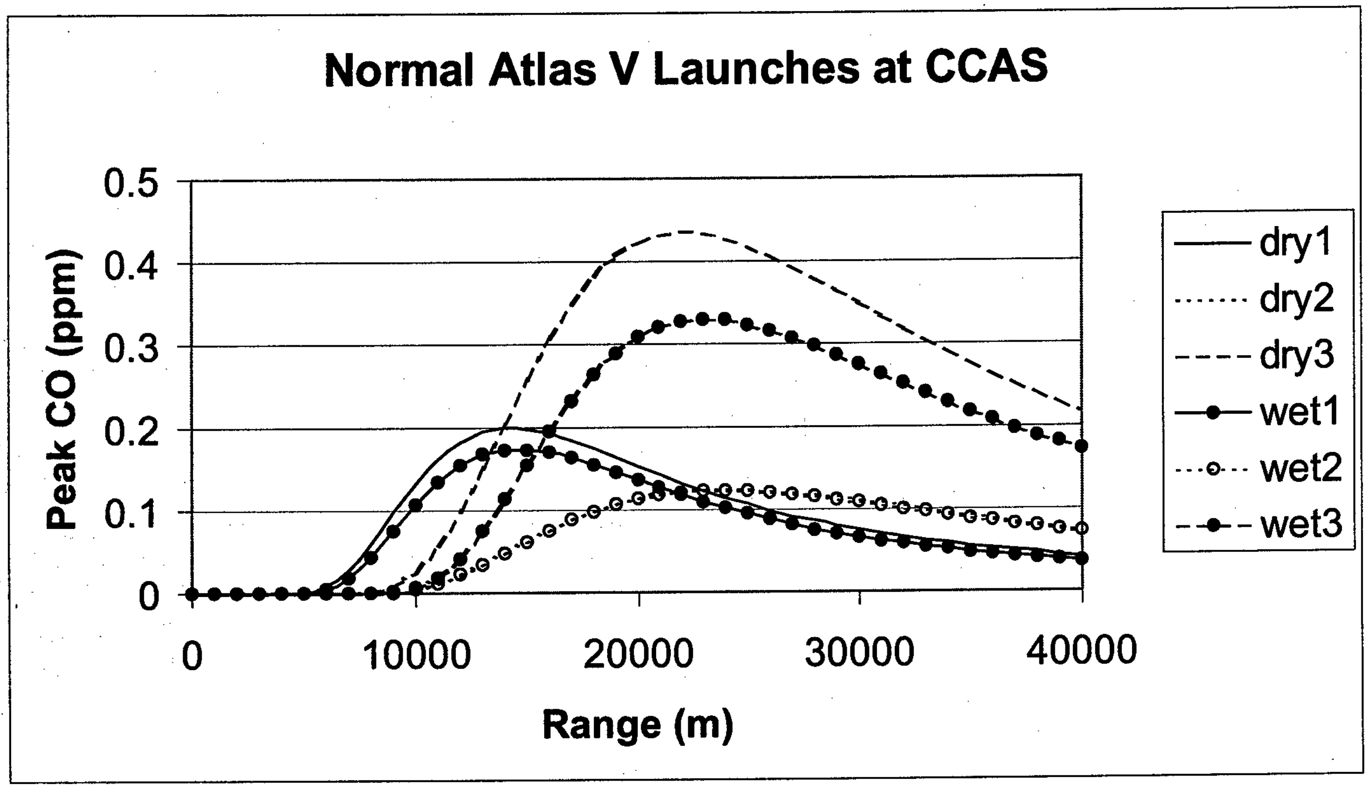


Figure 13: Peak Downwind Ground Level HCl from Normal Atlas V Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

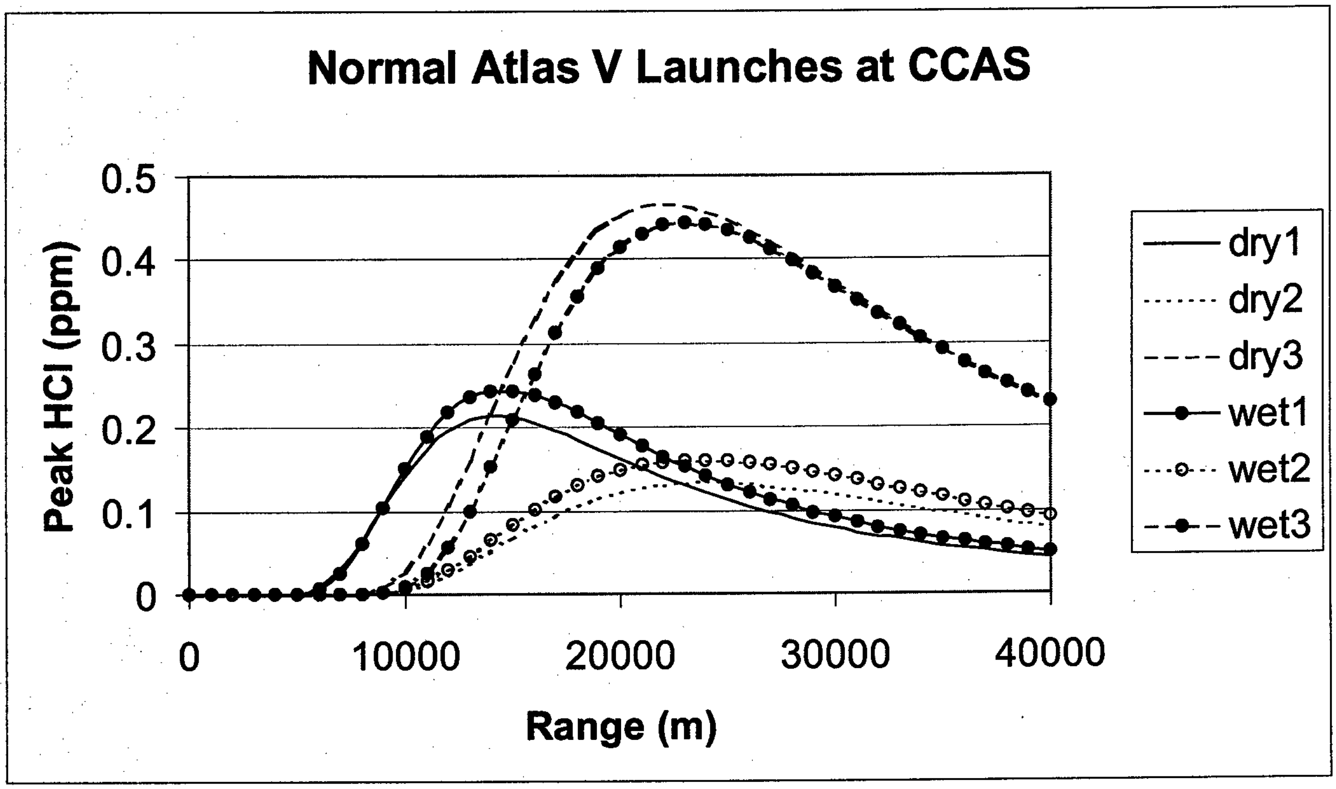


Figure 14: Peak Downwind Ground Level CO from Atlas V Launch Failures at CCAFS.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes, and 4 is large and small dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 6 seconds after ignition, t+6, is a line marked with an X, 12 seconds is an asterisk, 18 seconds is a circle, 24 seconds is a triangle, and 30 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

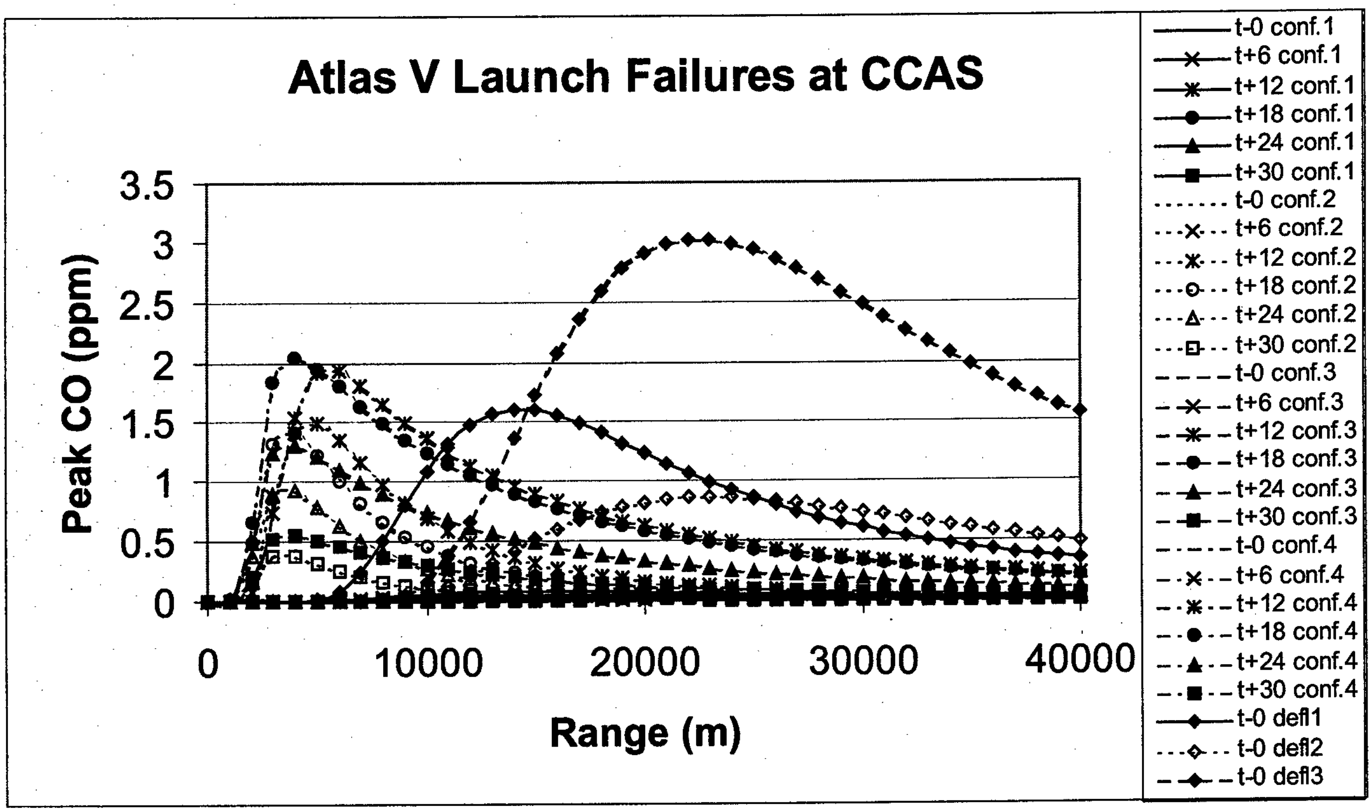


Figure 15: Peak Downwind Ground Level HCl from Atlas V Launch Failures at CCAFS.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, and 3 is large dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 6 seconds after ignition, t+6, is a line marked with an X, 12 seconds is an asterisk, 18 seconds is a circle, 24 seconds is a triangle, and 30 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

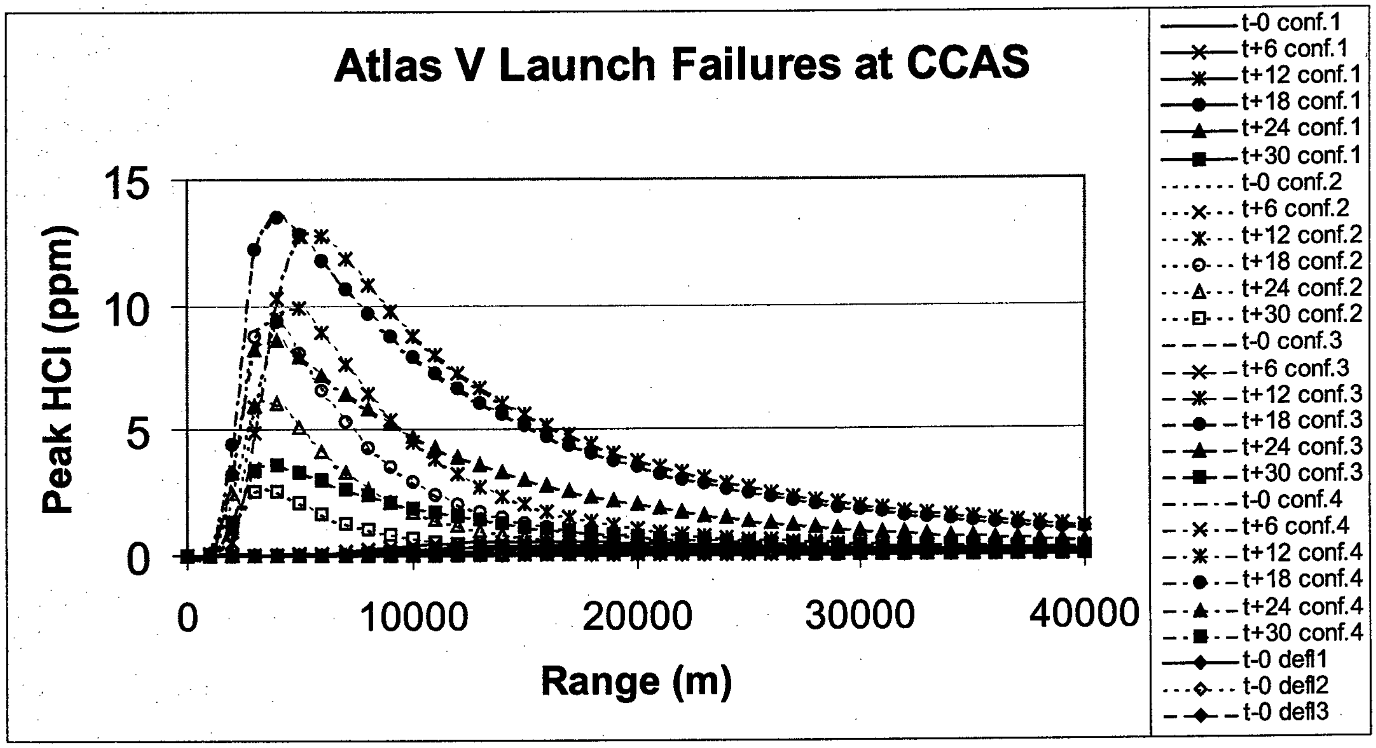


Figure 16: Peak Downwind Ground Level PM10 from Normal Delta IV Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types; met case 1 is a solid line, 2 is small dashes, 3 is large dashes, and 4 is large and small dashes. For 'wet' launches the fill of the symbol also varies with met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

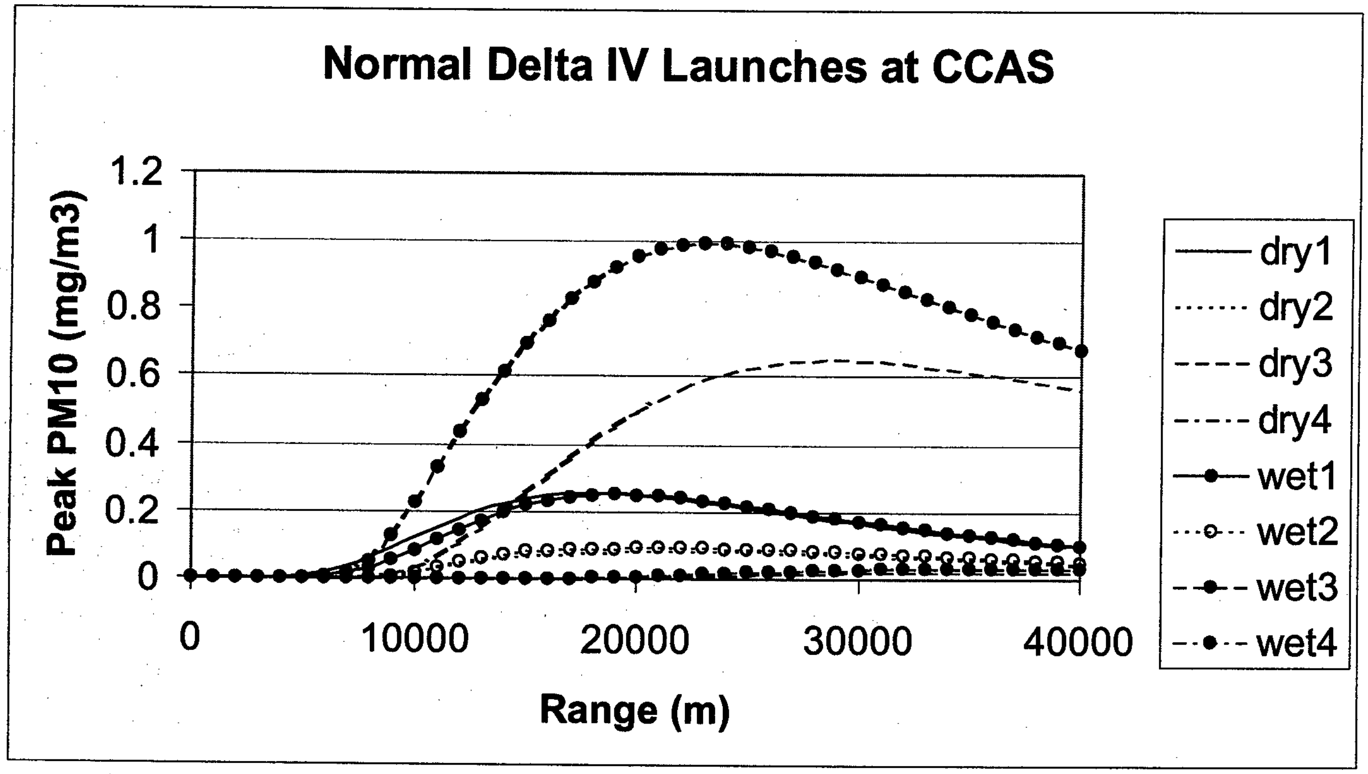


Figure 17: Peak Downwind Ground Level CO from Normal Delta IV Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

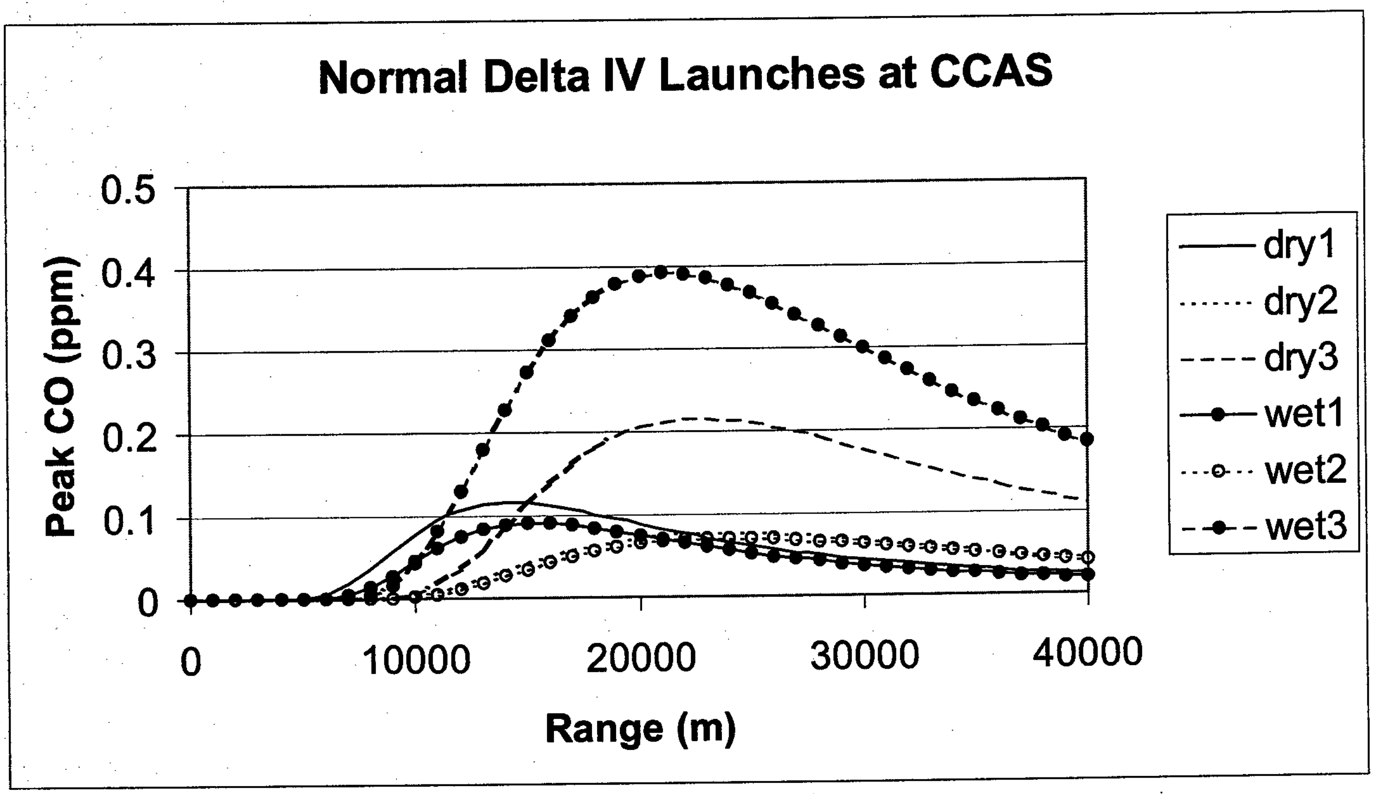


Figure 18: Peak Downwind Ground Level HCl from Normal Delta IV Launches at CCAFS.

As explained in the text, a 'dry' normal launch is one with no sound suppression water, 'wet' includes enough water to saturate the ground cloud. Dry launches are shown as lines with no symbols; lines with circles are for wet launches. Different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes; other met cases gave ground concentrations below the REEDM cutoff of 0.0005 ppm. For 'wet' launches the fill of the symbol also varies with met case for clarity; met case 1 is black, 2 is clear, and 3 is grey. Detailed descriptions of the met cases are given in this appendix.

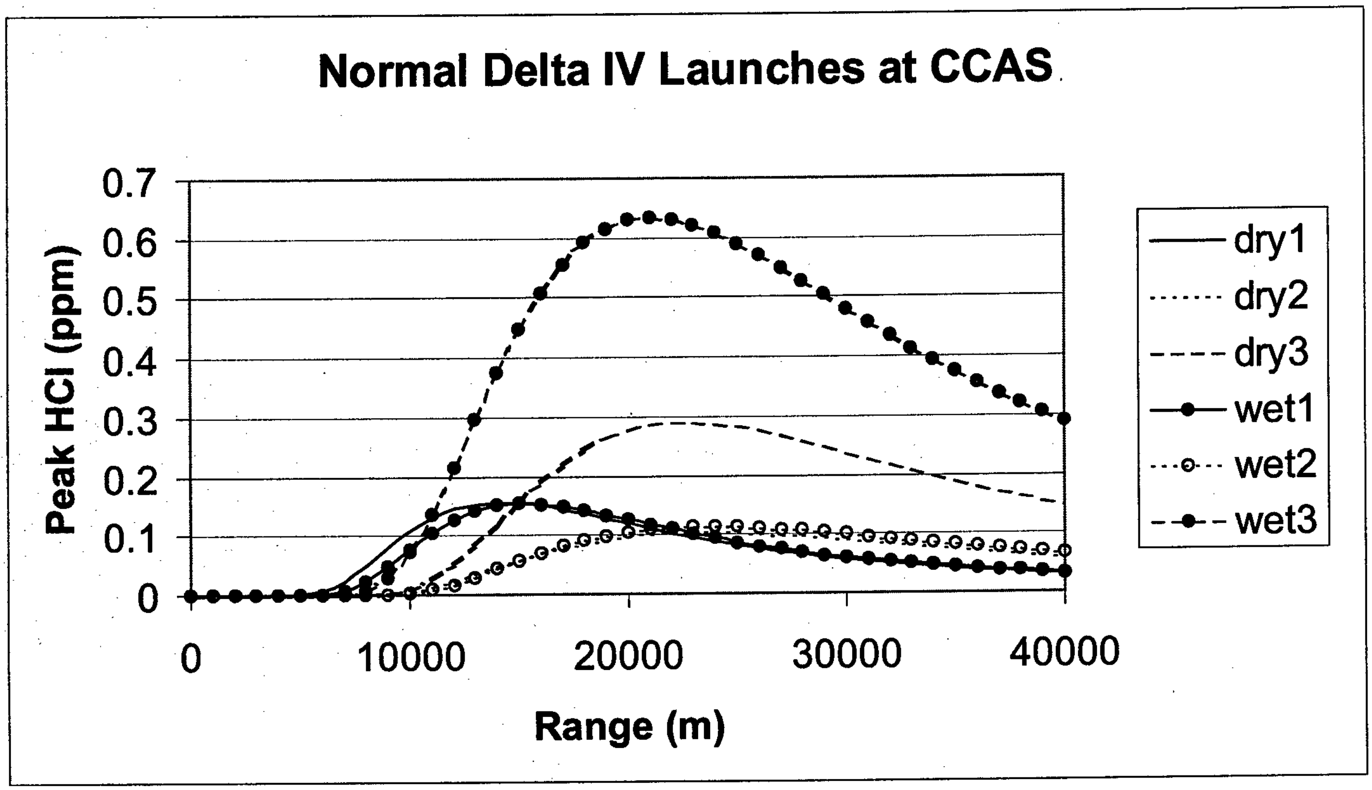


Figure 19: Peak Downwind Ground Level CO from Delta IV Launch Failures at CCAFS.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes, and 4 is large and small dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 4 seconds after ignition, t+4, is a line marked with an X, 8 seconds is an asterisk, 12 seconds is a circle, 16 seconds is a triangle, and 20 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Only 3 met cases generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.

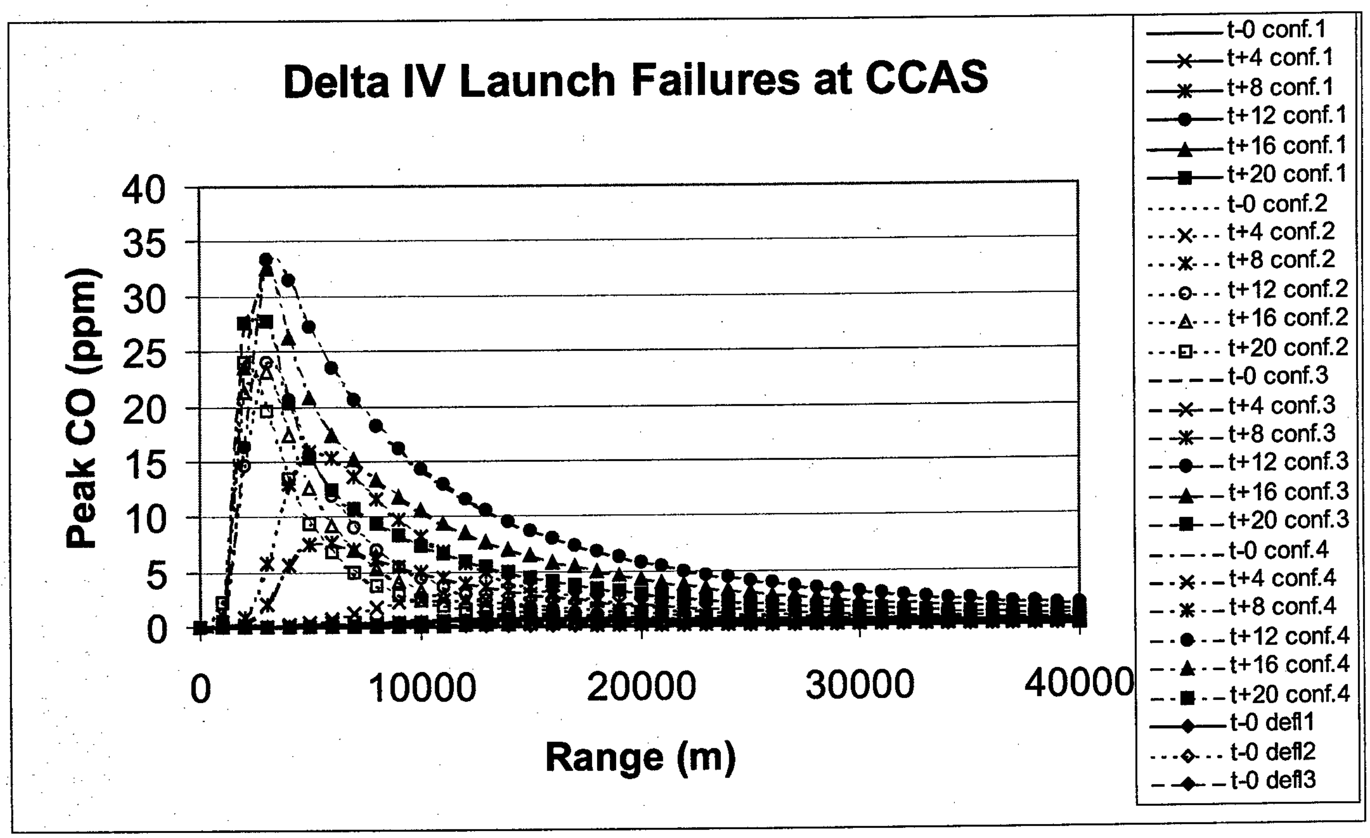
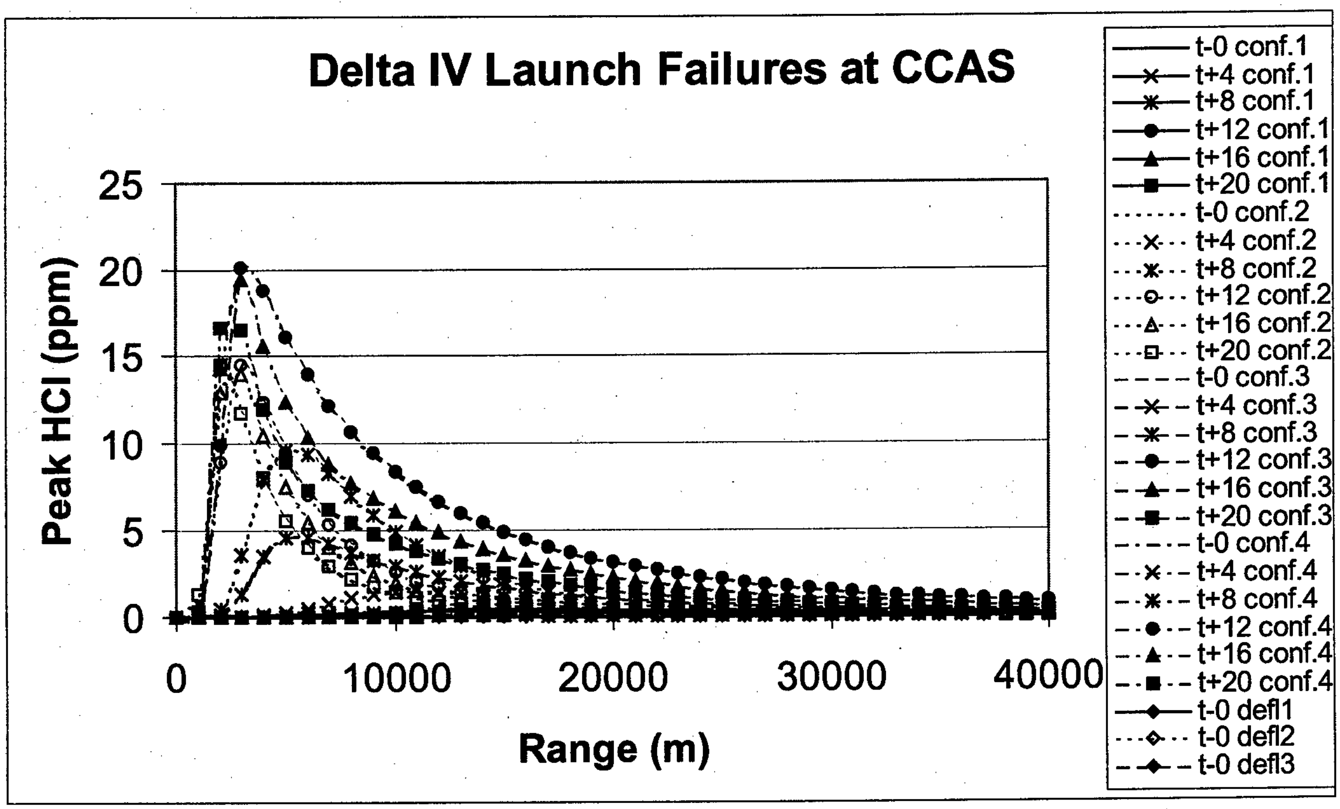


Figure 20: Peak Downwind Ground Level HCl from Delta IV Launch Failures at CCAFS.

As in the Normal Launch figures, different meteorological cases are shown as different line types. Met case 1 is a solid line, 2 is small dashes, 3 is large dashes, and 4 is large and small dashes. Symbols are used to differentiate the different launch failure scenarios. For the conflagration events, symbols are used to differentiate the flight failure times; failure at ignition, t-0, is a line with no symbol, failure at 4 seconds after ignition, t+4, is a line marked with an X, 8 seconds is an asterisk, 12 seconds is a circle, 16 seconds is a triangle, and 20 seconds is a square. A diamond marks the deflagration event which is only run for a failure at ignition. The fill of the symbols varies with the met case for clarity; met cases 1 and 4 are black, 2 is clear, and 3 is grey. Only 3 met cases generated downwind ground concentrations above the REEDM cutoff of 0.0005 ppm for the deflagration event. Detailed descriptions of the met cases and the failure scenarios are given in this appendix.



Appendix U
Noise Methods of Analysis

Introduction

Noise is generally described as unwanted sound. Unwanted sound can be based on objective effects (hearing loss, damage to facilities, etc.) or subjective judgments (community annoyance). Noise analysis requires a combination of physical measurement of sound, physical and physiological effects, plus psycho- and socioacoustic effects.

Section 1.0 of this appendix describes how sound is predicted and measured, Section 2.0 describes the effect of noise on people, facilities, and wildlife, and Section 3.0 provides a summary description of the specific methods used to predict noise from Evolved Expendable Launch Vehicle (EELV) program activities.

1.0 Noise Descriptors and Prediction

EELV program launch vehicles would generate two types of sound—engine noise (continuous sound) and sonic booms (transient, impulsive sounds). These types of sounds are quantified in separate ways.

1.1 Noise Descriptors

Measurement and perception of sound involves two basic physical characteristics: amplitude and frequency. Amplitude is a measure of the strength of the sound and is directly measured in terms of the pressure of a sound wave. Because sound pressure varies in time, various types of pressure averages are usually used. Frequency, commonly perceived as pitch, is the number of times per second the sound causes air molecules to oscillate. Frequency is measured in units of cycles per second, or hertz (Hz).

Amplitude

The loudest sounds the human ear can comfortably hear have acoustic energy one trillion times the acoustic energy of sounds the ear can barely detect. Because of this vast range, attempts to represent sound amplitude by pressure are generally unwieldy. Sound is therefore usually represented on a logarithmic scale with a unit called the decibel (dB). Sound on the decibel scale is referred to as a sound level. The threshold of human hearing is approximately 0 dB, and the threshold of discomfort or pain is around 120 dB.

The difference in dB between two sounds represents the ratio of those two sounds. Because human senses tend to be proportional (i.e., detect whether one sound is twice as loud as another) rather than absolute (i.e., detect whether one sound is a given number of pressure units bigger than another), the decibel scale correlates well with human response.

Frequency

The normal human ear can hear frequencies from about 20 Hz to about 15,000 or 20,000 Hz. It is most sensitive to sounds in the 1,000 to 4,000 Hz range. When measuring community response to noise, it is common to adjust the frequency content of the measured sound to correspond to the frequency sensitivity of the human ear. This adjustment is called A-weighting (American National Standards Institute, 1988). Sound levels that have been so adjusted are referred to as A-weighted sound levels. The amplitude of A-weighted sound levels is measured in dB. It is common for some noise analysts to denote the unit of A-weighted sounds by dBA or dB(A). As long as the use of A-weighting is understood, there is no difference between dB, dBA or dB(A). It is only important that the use of A-weighting be made clear. It is common to use the term A-weighted sound pressure level (AWSPL) to refer to A-weighted sounds.

For analysis of damage to structures by sound, it is common not to apply any frequency weighting. Such overall sound levels are measured in dB and are often referred to as overall sound pressure levels (OASPL or OSPL).

C-weighting (American National Standards Institute, 1988) is sometimes applied to sound. This is a frequency weighting that is flat over the range of human hearing (about 20 Hz to 20,000 Hz) and rolls off above and below that range. C-weighted sound levels are often used to analyze high-amplitude impulsive noise, where adverse impact is influenced by rattle of buildings.

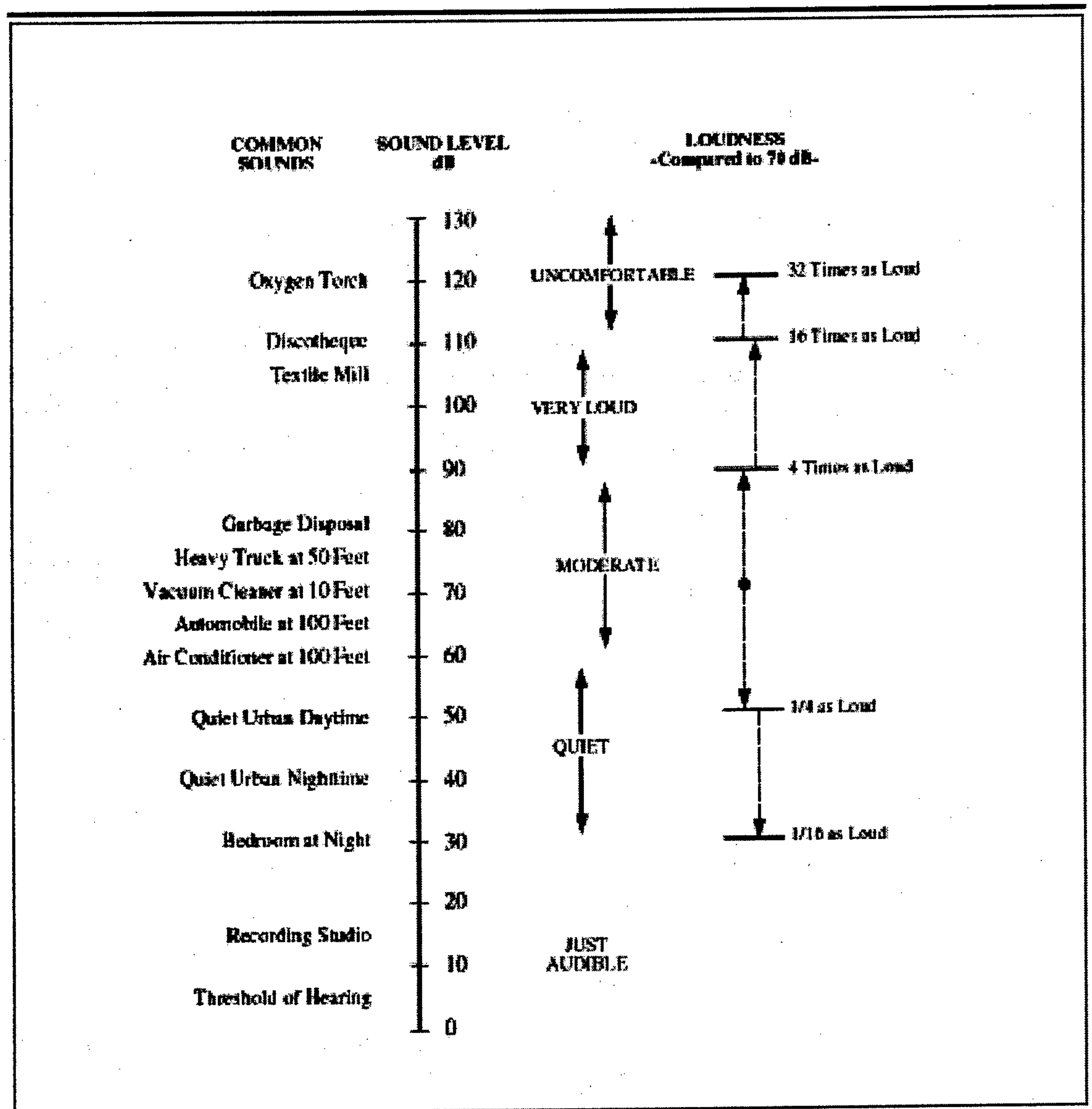
Time Averaging

Sound pressure of a continuous sound varies greatly with time, so it is customary to deal with sound levels that represent averages over time. Levels presented as instantaneous (i.e., as might be read from the dial of a sound level meter), are based on averages of sound energy over either 1/8 second (fast) or one second (slow). The formal definitions of fast and slow levels are somewhat complex, with details that are important to the makers and users of instrumentation. They may, however, be thought of as levels corresponding to the root-mean-square sound pressure measured over the 1/8-second or 1-second periods.

The most common uses of the fast or slow sound level in environmental analysis are in the discussion of the maximum sound level that occurs from the action, and in discussions of typical sound levels. Figure U-1 shows a chart of sound levels from typical sounds.

Assessment of cumulative noise impact requires average levels over periods longer than just the fast or slow times. The sound exposure level (SEL) sums the total sound energy over a noise event. Mathematically, the mean square sound pressure is computed over the duration of the event, then multiplied by the duration in seconds, and the resultant product is turned into a sound level. SEL is sometimes described as the level that, occurring for one second, would have the same sound energy as the actual event.

Note that SEL is a composite metric that combines both the amplitude of a sound and its duration. It is a better measure of noise impact than the maximum sound level alone, because it accounts for duration. Long sounds are more intrusive than short sounds of equal level, and it has been well established that SEL provides a good measure of this effect.



A-Weighted Sound Levels of Common Sounds

Figure U-1

Source: Handbook of Noise Control, C.M. Harris, Editor, McGraw-Hill Book Co., 1979

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SEL can be computed for A- or C-weighted levels, and the results can be denoted as ASEL or CSEL. It can also be computed for unweighted (overall) sound levels, with a corresponding designation.

For longer periods of time, total sound is represented by the equivalent continuous sound pressure level (L_{eq}). L_{eq} is the average sound level over some time period (often an hour or a day, but any explicit time span can be specified) with the averaging being done on the same energy basis as used for SEL. SEL and L_{eq} are closely related, differing according to: (a) whether they are applied over a specific time period or over an event, and (b) whether the duration of the event is included or divided out.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{eq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{eq} is defined as an average, it is effectively a sum over that time period, so is a measure of the cumulative impact of noise.

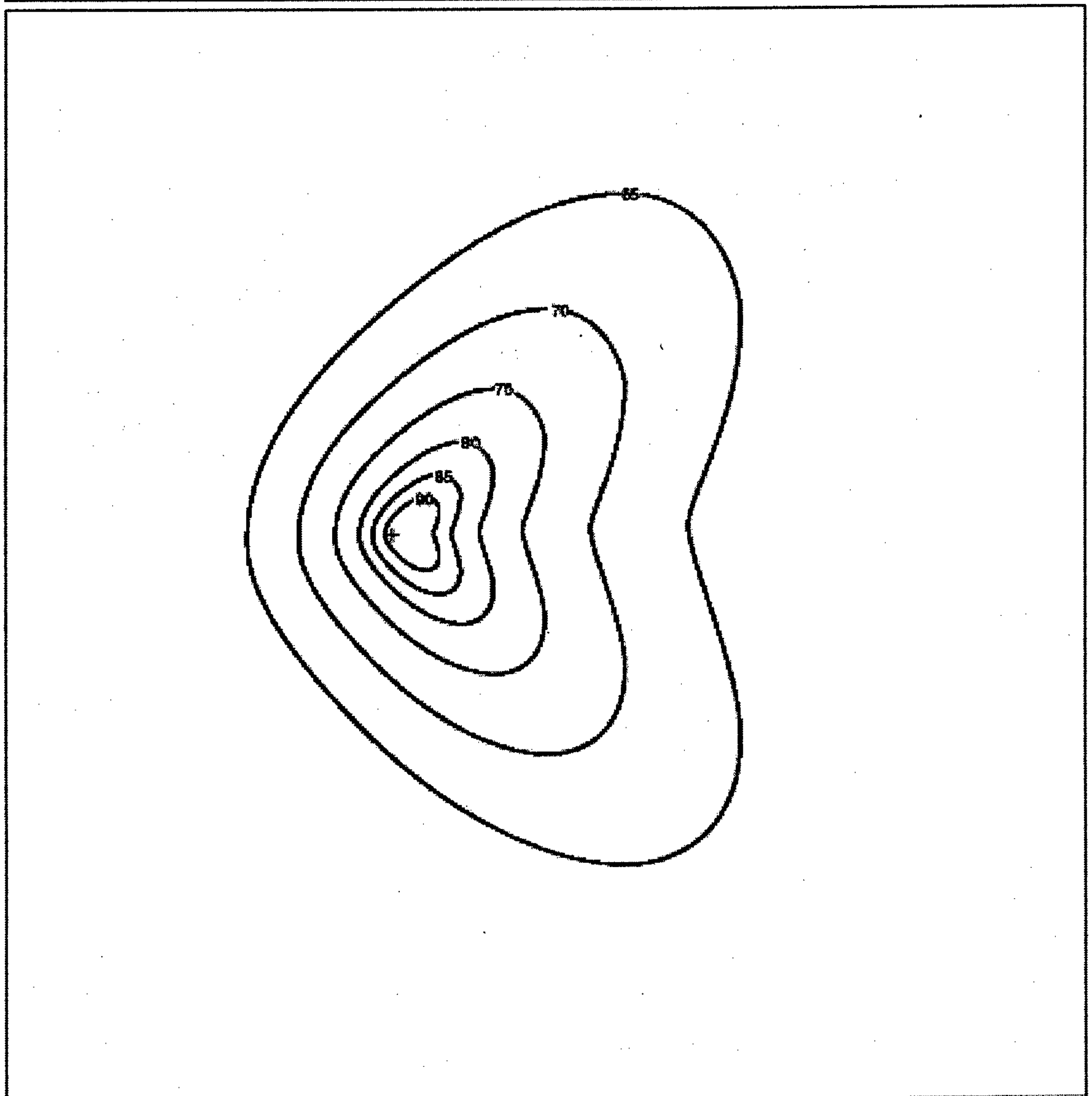
Noise tends to be more intrusive at night than during the day. This effect is accounted for by applying a 10-dB penalty to events that occur after 10 p.m. and before 7 a.m. If L_{eq} is computed over a 24-hour period with this nighttime penalty applied, the result is the day-night average sound level (L_{dn} or DNL). L_{dn} is the community noise metric recommended by the U.S. Environmental Protection Agency (U.S. Environmental Protection Agency, 1972) and has been adopted by most federal agencies (Federal Interagency Committee on Noise, 1992). It has been well established that L_{dn} correlates well with community response to noise (Schultz, 1978; Finegold, 1994).

The state of California quantifies noise by Community Noise Equivalent Level (CNEL). This metric is similar to L_{dn} except that a penalty of 5 dB is applied to sounds that occur in the evening, after 7:00 p.m. and before 10:00 p.m.

It was noted earlier that, for impulsive sounds, C-weighting is more appropriate than A-weighting. The day-night average sound level can be computed for C-weighted noise, and is denoted L_{Cdn} or CDNL. This procedure has been standardized, and impact-interpretive criteria similar to those for L_{dn} have been developed (CHABA, 1981).

1.2 Rocket Noise

Rocket noise is generated primarily by mixing high-speed rocket exhaust flow with the atmosphere. Noise is also generated by fuel and oxidizer burning in the combustion chamber, shock waves and turbulence within the exhaust flow, and sometimes, burning of excess fuel in the exhaust flow. The result is a high-amplitude continuous sound, directed generally behind the vehicle. Figure U-2 shows the typical pattern of noise behind a rocket engine. In this illustration, the exhaust flow is horizontal, directed toward the east (right). This depiction corresponds to a horizontally mounted rocket (common in ground testing of engines) or a rocket on a launch pad where a deflector has turned the exhaust sideways. Noise is shown as contours of various decibel values. All points inside a given contour experience noise equal to or higher than that contour value. The pattern is fairly uniform in the forward direction (toward the left in this figure), has high-amplitude lobes at around 45 degrees from the flow direction (the angle of the lobes varies), and has a minimum directly in line with the exhaust.



EXPLANATION

—80— Noise Contour (decibels)

Nominal Noise Contours for Horizontal Firing Rocket Engine

Figure U-2

Not to Scale

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When a rocket is launched, after a short time, it is above the ground and the exhaust is clear of the ground and any deflectors. When the rocket is climbing vertically, the noise contours on the ground are circular. As the rocket continues to climb, it would pitch over in its launch azimuth. The contours would be distorted in this direction, sometimes becoming stretched and sometimes broadened, depending on details of the particular vehicle and launch. Figure U-3 shows typical noise contours for a launch toward the east. The trajectory is indicated, and the launch point is at the center of the innermost contours.

In Figure U-2, as long as the rocket is on the ground the noise is constant, and the contours show what would be measured at any time while the engine is firing. For a launch, as in Figure U-3, noise is not constant. It is loudest shortly after launch, then diminishes as the rocket climbs. The noise is still considered to be continuous because it varies over periods of seconds or minutes. Contours of AWSPL or OSPL are drawn to represent the maximum levels that occur at each point during the entire launch. These levels may only occur for a few seconds and do not occur at the same time at each point, but are the most important (i.e., worst-case) quantity for assessing launch noise impact.

In this assessment, contours (similar to Figure U-3) are presented for launch noise. Because contours are approximately circular, it is often adequate to summarize noise by giving the sound levels at a few distances from the launch site.

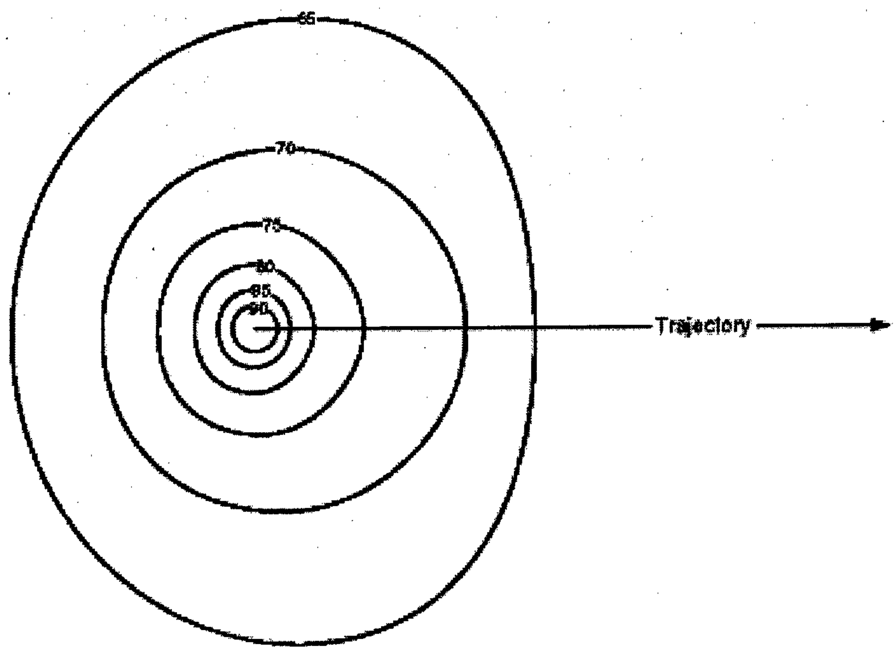
1.3 Sonic Booms

When launch vehicles reach supersonic speed, they generate sonic booms. Sonic booms are the shock waves resulting from the displacement of air in supersonic flight. They differ from other sounds in that they are impulsive and brief.

Figure U-4 is a sketch of a sonic boom for the simple case of an aircraft in steady-level flight. The aircraft is flying to the left. The sonic boom consists of two shock waves: one generally associated with the front of the aircraft, and one with the rear. They are connected by a linear expansion. The pressure-time signature at the ground resembles the letter "N" and is referred to as an N-wave. It is described by the peak overpressure of each shock, and the time between the shocks. Usually the time between shocks does not affect impact, so sonic booms are most commonly described by their peak overpressures.

In Figure U-4, the sonic boom is generated continuously as the aircraft flies, and this illustration is from the perspective of moving with the aircraft. At a location on the ground, however, the boom exists briefly as the N-wave passes over that point. It is common to refer to the footprint of a steady-flight sonic boom as a "carpet," consisting of a "carpet" of area on the ground that is swept out as the aircraft flies along its path. N-wave booms are often referred to as "carpet booms."

Figure U-5 shows an aircraft sonic boom from a different perspective. The aircraft is flying to the right, and the cone to the left is a three-dimensional version of the shocks in Figure U-4. It is the boom as it exists at a given time. It is generated over a period of time, with the boom at the ground having been created at an earlier time. The sonic boom energy generated at a given time propagates forward of the aircraft, along a cone similar to the one projected to the right in Figure U-5. It reaches the ground in a forward-facing crescent, as indicated in the figure.



EXPLANATION

—— 80 —— Noise Contour (decibels)

Nominal Noise Contours for Ascent of a Launch Vehicle

Figure U-3

Not to Scale

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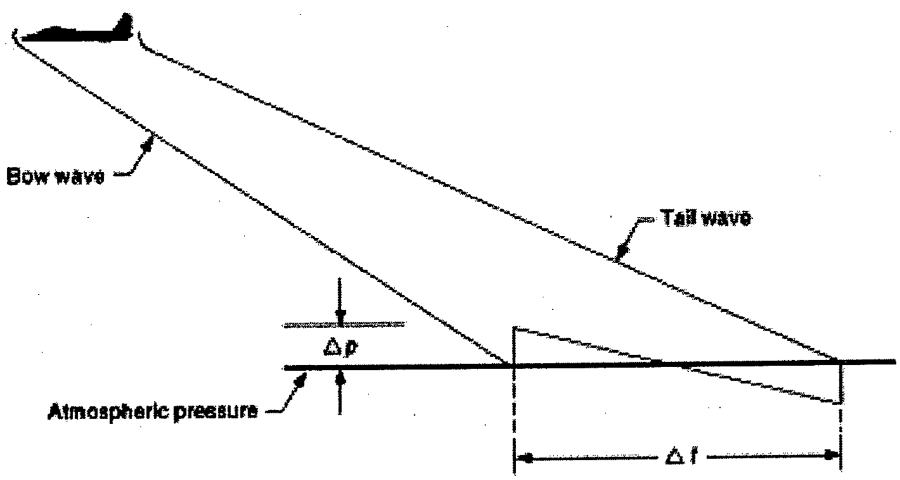
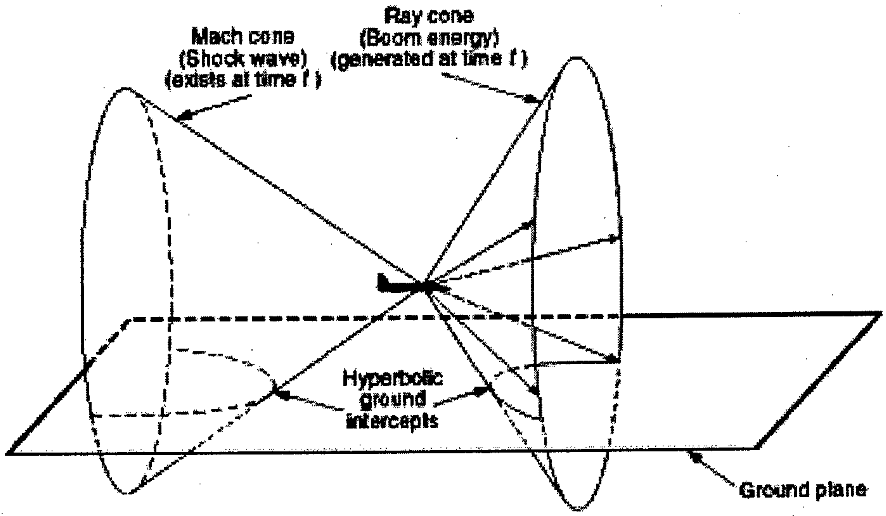


Sonic Boom From an Aircraft in Level Flight

Figure U-4

Not to Scale



Sonic Boom in Level Flight, Showing Shock Wave and Propogation of Boom Energy

Figure U-5

Not to Scale

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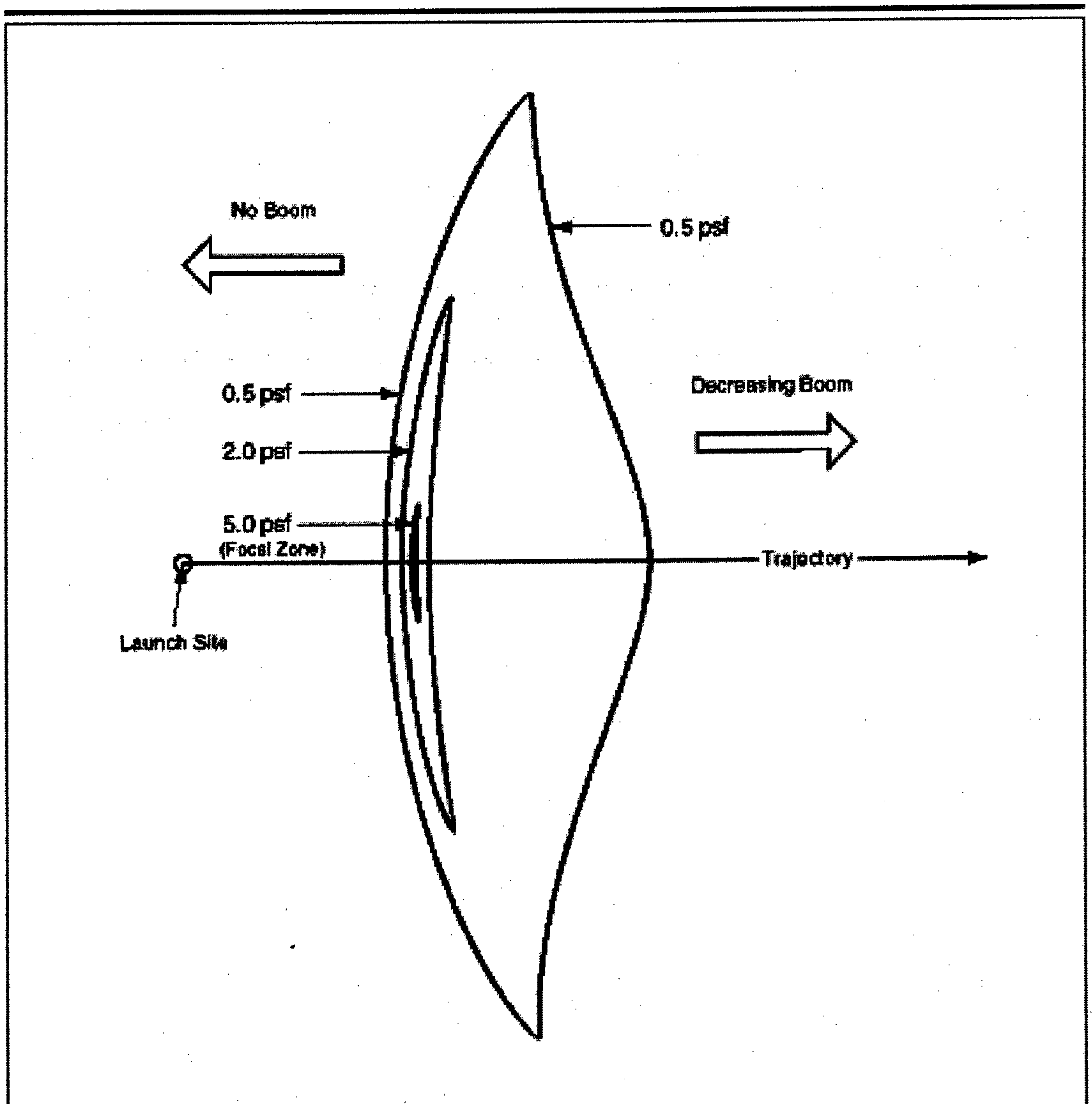
Sonic booms from launch vehicles differ from those sketched in Figures U-4 and U-5 in two ways. First, launch vehicles begin their flight vertically, then slowly pitch over toward the horizontal. Second, launch vehicles accelerate, so speed is continuously changing as they ascend. The cone angles shown in Figures U-4 and U-5 change with speed. Shock waves are generated only after the vehicle exceeds Mach 1, and the waves reach the ground as sonic booms only after the vehicle has pitched over and reached a particular Mach number. Figure U-6 shows nominal sonic boom noise contours (not to scale) from a launch vehicle. The contour values represent pressure in pounds per square foot (psf), the unit most commonly used. The launch site is noted on the figure, and the launch direction is to the right. As with the noise contours shown in Figures U-2 and U-3, regions within each contour experience overpressures equal to or greater than that denoted for the contour. Also, the contours denote the peak pressure that occurs at each point over the course of the launch and does not represent noise at any one time. The sonic boom event at each position is brief, as noted in the preceding paragraph.

Because sonic boom is not generated until the vehicle becomes supersonic sometime after launch, the launch site itself does not experience a sonic boom. The crescent shape of the contours reflects this "after-launch" nature of sonic boom: the entire boom footprint is downtrack, and portions of the footprint to the side of the trajectory (up and down in the figure) are farther downtrack. This pattern is similar to the forward-facing crescent seen in the right half of Figure U-5. There is no boom to the left of the contours shown, and the boom diminishes rapidly farther downtrack, to the right of the contours.

The left edge of the contours shown in Figure U-6 is a special region. Because the vehicle is accelerating, sonic boom energy tends to be more concentrated than if it were in steady flight. The left edge is where the boom first reaches the ground, and the concentration is highest there. There is a narrow "focus boom" or "superboom" region, usually less than 100 yards where the sonic boom amplitude is highest. The boom signature is also distorted into what is referred to as a "U-wave."

Figure U-7 shows time histories (pressure versus time) for N-wave carpet booms and U-wave focus booms. Each consists of a pair of shock waves connected by a linear expansion (N-wave) or a U-shaped curve (U-wave). Each type of boom is well described by its peak overpressure in psf, and its duration in milliseconds (msec). Duration tends to have a minor effect on impact, so the peak pressure is all that is normally required.

The 0.5-psf contour shown in Figure U-6, although not to scale, has a shape similar to an actual low-overpressure sonic boom contour. The two higher contours, 2.0 and 5.0 psf, are considerably distorted from typical actual contours. The crescent shape is correct, and their width across the trajectory (i.e., vertical height on this figure) relative to the 0.5-psf contour is approximately correct. Their width and position in the direction along the trajectory is greatly exaggerated. It is typical that the left edge of these higher contours would be very close to the left edge of the 0.5-psf contour, and would not appear as a distinct line when plotted to any reasonable scale. The right edge of these contours would also be much closer to the left than shown, and would often not appear as distinct lines. The focus boom region is within the 0.5-psf contour.



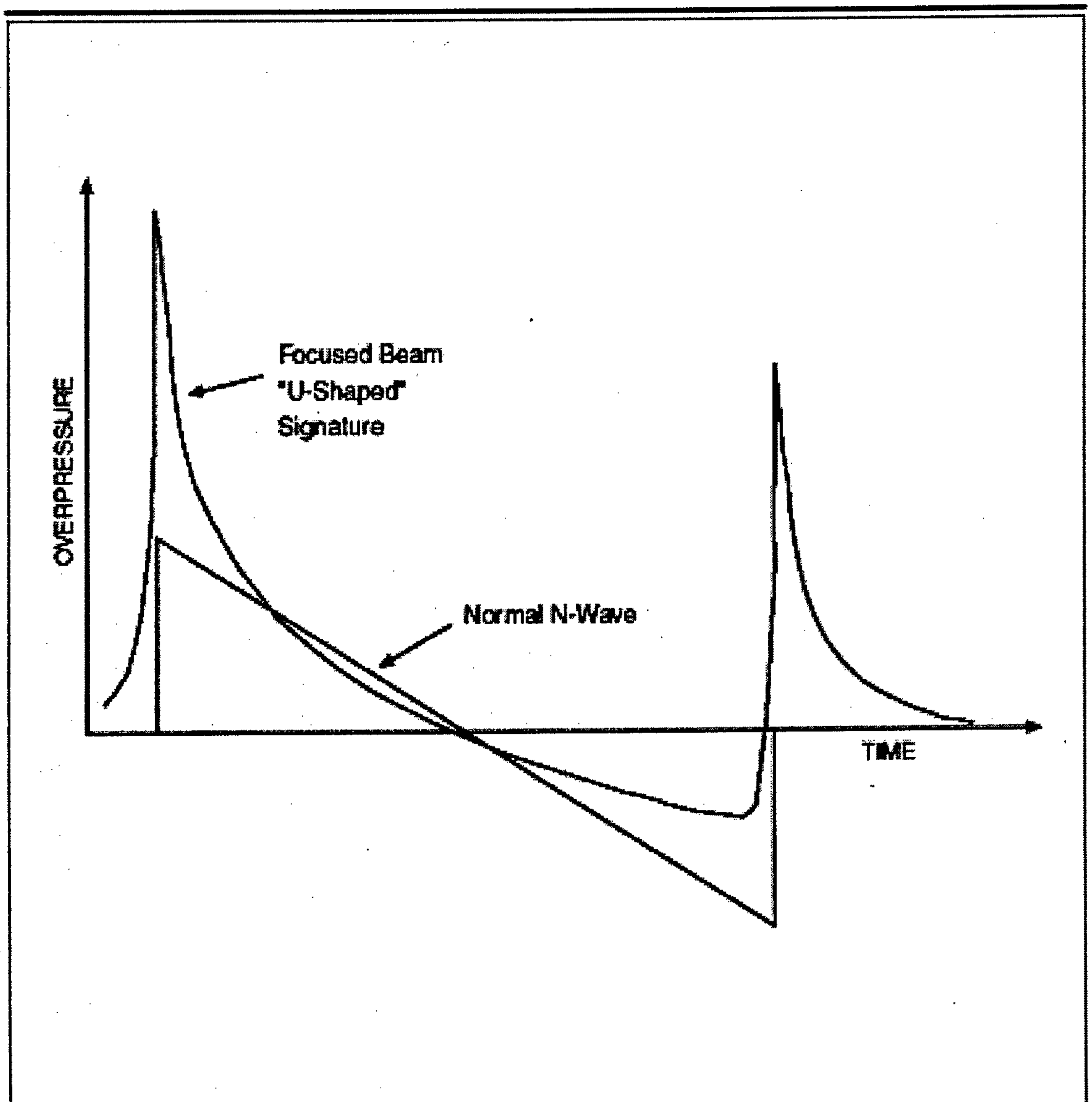
EXPLANATION

psf Pounds per square foot

Nominal Sonic Boom Contours for Ascent of a Launch Vehicle

Figure U-6

Not to Scale



Focused U-Wave and Unfocused N-Wave Boom Signatures

Figure U-7

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For assessment of impact via L_{Cdn}, as discussed in Section 1.1, the peak pressure is related in a simple way to CSEL, from which L_{Cdn} can be constructed. The peak pressure P (psf) is converted to the peak level (L_{pk}) dB by the relation:

$$L_{pk} = 127.6 + 20 \log_{10} P$$

CSEL is then given by Plotkin (1993):

$$CSEL = L_{pk} - 26 \qquad \text{(N-wave)}$$

$$CSEL = L_{pk} - 29 \qquad \text{(U-wave)}$$

Most sonic boom literature describes booms in terms of overpressure psf. This assessment adheres to that convention. The above relations give simple conversions to decibels should those units be of interest.

2.0 Noise Effects

2.1 Annoyance

Studies of community annoyance from numerous types of environmental noise show that L_{dn} is the best measure of impact. Schultz (1978) showed a consistent relationship between L_{dn} and annoyance. This relationship, referred to as the "Schultz curve," has been reaffirmed and updated over the years (Fidell, 1991; Finegold, 1994). Figure U-8 shows the current version of the Schultz curve.

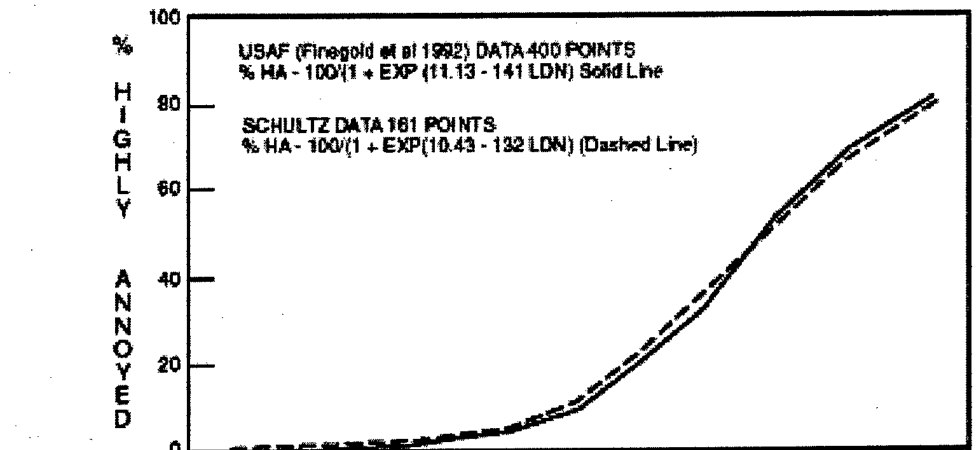
A limitation of the Schultz curve is that it is based on long-term exposure to noise. EELV program launches would be relatively infrequent, so analysis in the current study examines individual noise levels rather than L_{dn} compared to the Schultz curve.

Some time ago, an L_{dn} of 55 dB or less was identified as a threshold below which adverse impacts to noise are not expected (U.S. Environmental Protection Agency, 1972). It can be seen from Figure U-8 that this is a region where a small percentage of people are highly annoyed. An L_{dn} of 65 dB is widely accepted as a level above which some adverse impact should be expected (Federal Interagency Committee on Noise, 1992), and Figure U-8 demonstrates that about 15 percent of people are highly annoyed at that level.

2.2 Speech Interference

Conversational speech is in the 60- to 65-dB range, and interference with this can occur when noise enters or exceeds this range. Speech interference is one of the primary causes of annoyance. The Schultz curve incorporates the aggregate effect of speech interference on noise impact.

Because EELV program launches would be infrequent, and noise would last for only a few minutes, speech interference is not expected to be a major issue.



Day - Night Average Sound Level in dB		40	45	50	55	60	65	70	75	80	85	90
Calculated % HA Points	USAF	0.41	0.831	1.66	3.31	6.48	12.29	2.21	36.47	53.47	70.16	82.64
	SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Community Response to Noise

Figure U-8

2.3 Sleep Interference

Sleep interference is commonly believed to represent a significant noise impact. The 10-dB nighttime penalty in L_{dn} is based primarily on sleep interference. Recent studies, however, show that sleep interference is much less than had been previously believed (Pearsons, 1989; Ollerhead, 1992).

Traditional studies of sleep disturbance indicate that interference can occur at levels as low as 45 dB. Data indicate that at an indoor SEL of 70 dB, approximately 20 percent of people would awaken (Federal Interagency Committee on Noise, 1992). Assuming a nominal outdoor-to-indoor noise reduction of 20 dB, these two measurements (45 dB and 70 dB) correspond to outdoor sound exposure levels of 65 dB and 90 dB, respectively. Note that the awakening threshold is comparable to the threshold of outdoor speech interference.

2.4 Task Interference

As a result of startle effects, some task interference may occur from sonic booms. High levels of rocket noise may cause some task interference close to the launch sites. It is difficult to estimate degrees of task interference, because such interference is highly dependent on specific tasks. Startle from sonic booms is often stated as a concern, but there are no credible reported incidents of harm from sonic boom startle. Task interference from rocket noise is expected to occur at higher noise levels than speech interference.

2.5 Hearing Loss

Federal Occupational Safety and Health Administration (OSHA) guidelines (Title 29 CFR 1910.95) specify maximum noise levels to which workers may be exposed on a regular basis without hearing protection. Pertinent limits are a maximum of 115 dBA for up to 15 minutes per day, and unweighted impulsive noise of up to 140 dB. Exceeding these levels on a daily basis over a working career is likely to lead to hearing impairment. These levels are conservative for evaluating potential adverse effects from occasional noise events.

2.6 Health

Nonauditory effects of long-term noise exposure, where noise may act as a risk factor, have never been found at levels below federal guidelines established to protect against hearing loss. Most studies attempting to clarify such health effects found that noise exposure levels established for hearing protection would also protect against nonauditory health effects (von Gierke, 1990). There are some studies in the literature that claim adverse effects at lower levels, but these results have generally not been reproducible.

2.7 Structures

2.7.1 Launch Noise

Damage to buildings and facilities from noise is generally caused by low-frequency sounds. The probability of structural damage claims has been found to be proportional to the intensity of the low-frequency sound. Damage claim experience (Guest and Sloane, 1972) suggests that one claim in 10,000 households is expected at a level of 103 dB, one in 1,000 households at 111 dB, and one in 100 households at 119 dB.

Figure U-9 shows criteria for damage to residential facilities (Sutherland, 1968) and compares them to launch noise spectra that could occur a few kilometers from the launch pad. These data show that noise-induced damage to off-base property would be minimal.

2.7.2 Sonic Boom

Sonic booms are commonly associated with structural damage. Most damage claims are for brittle objects, such as glass and plaster. Table U-1 summarizes the threshold of damage that might be expected at various overpressures. There is a large degree of variability in damage experience, and much damage depends on the pre-existing condition of a structure. Breakage data for glass, for example, spans a range of two to three orders of magnitude at a given overpressure. While glass can suffer damage at low overpressures (shown in Table U-1) laboratory tests of glass (White, 1972) have shown that properly installed window glass would not break at overpressures below 10 psf, even when subjected to repeated booms.

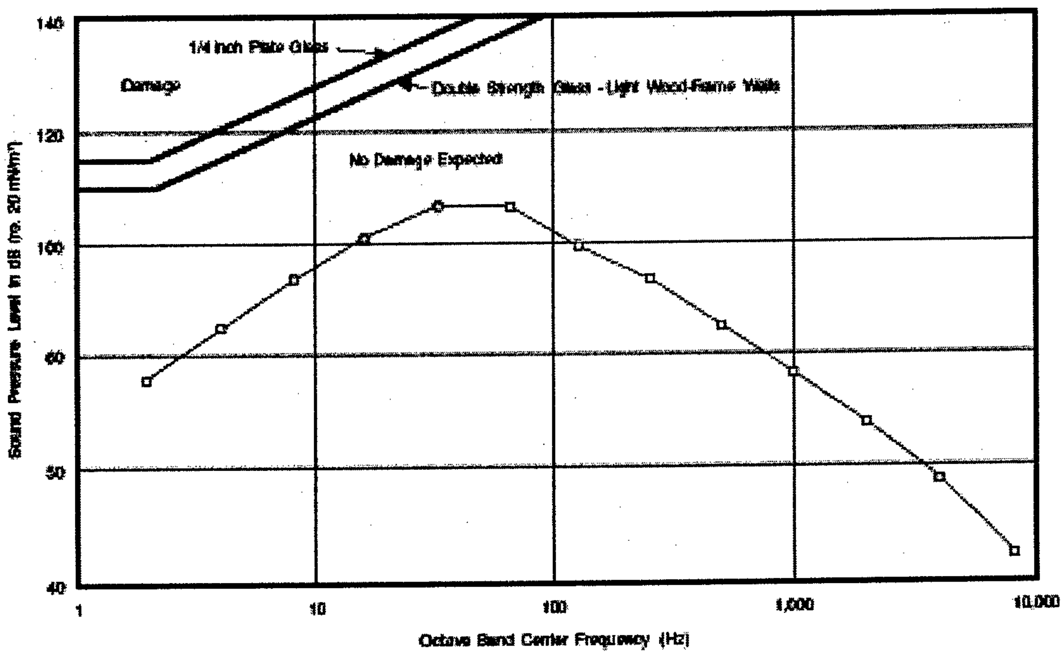
Most of the area exposed to sonic booms would be below 2 psf, where there is a small probability of damage. Additionally, the BLAST over-pressure program will be run for all launches for the proposed action, to determine the risk level to individuals due to glass breakage resulting from a vehicle explosion on or near the launch pad. Boom amplitude would exceed this in limited areas associated with focusing, with maximum overpressures in the 6- to 8-psf range. Because of the limited area involved in a focal zone, adverse impact would depend on the relation of the focal zones to sensitive receptors.

2.8 Wildlife

The response to sonic booms or other sudden disturbances is similar among many species (Moller, 1978). Sudden and unfamiliar sounds usually act as an alarm and trigger a "fight-or-flight" startle reaction. This sudden panic response may cause wildlife to injure themselves or their young, but this is usually the result of the noise in association with the appearance of something perceived by the animals as a pursuit threat, such as a low-flying aircraft. Launch noise is not expected to cause more than a temporary startle-response, because the "pursuit" would not be present. Any loss or injury as a result of this startle response would be incidental, and not a population-wide effect. Animals control their movements to minimize risk. Loss rates have varied greatly in the few documented cases of injury or loss: mammals and raptors appear to have little susceptibility to those losses; the most significant losses have been observed among waterfowl. Panic responses typically habituate quickly and completely with fewer than five exposures (Bowles, 1997).

During a Titan II launch from SLC-4 at Vandenberg AFB, all snowy plovers flushed and settled in a somewhat different flock configuration. One-half mile south of the Santa Ynez River, no discernible response occurred during launch. The snowy plovers stood from roost sites and walked one meter from original roosting position. The reaction exhibited resembled the response to a perceived predator threat, including a return to normal behavior when the perceived threat had passed (Read, 1996a,b).

The startling effect of a sonic boom can be stressful to an animal. This reaction to stress causes physiological changes in the neural and endocrine systems, including increased blood pressure and higher levels of available glucose and corticosteroids in the bloodstream. Continued disturbances and prolonged exposure to severe stress may deplete nutrients available to the animal.



Criteria for Noise Damage to Residential Structures and Typical Off-Base Launch Noise Spectrum

Figure U-9

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TABLE U-1
Possible Damage to Structures From Sonic Booms

Sonic Boom Overpressure Nominal (psf)	Type of Damage	Item Affected
0.5-2	Cracks in plaster	Fine; extension of existing; more in ceilings; over door frames; between some plaster boards.
	Cracks in glass	Rarely shattered; either partial or extension of existing.
	Damage to roof	Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole.
	Damage to outside walls	Existing cracks in stucco extended.
	Bric-a-brac	Those carefully balanced or on edges can fall; fine glass, e.g., large goblets, can fall and break.
	Other	Dust falls in chimneys.
2-4	Glass, plaster, roofs, ceilings	Failures show that would have been difficult to forecast in terms of their existing localized condition. Nominally in good condition.
4-10	Glass	Regular failures within a population of well-installed glass; industrial as well as domestic greenhouses.
	Plaster	Partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured, or very old plaster.
	Roofs	High probability rate of failure in nominally good state, slurry-wash; some chance of failures in tiles on modern roofs; light roofs (bungalow) or large area can move bodily.
	Walls (out)	Old, free standing, in fairly good condition; can collapse.
	Walls (in)	Interior walls known to move at 10 psf.
Greater than 10	Glass	Some good glass would fail regularly to sonic booms from the same direction. Glass with existing faults could shatter and fly. Large window frames move.
	Plaster	Most plaster affected.
	Ceilings	Plaster boards displaced by nail popping.
	Roofs	Most slate/slurry roofs affected, some badly; large roofs having good tile can be affected; some roofs bodily displaced causing gable-end and wall-plate cracks; domestic chimneys dislodged if not in good condition.
	Walls	Interior walls can move even if carrying fittings such as hand basins or taps; secondary damage from water leakage.
	Bric-a-brac	Some nominally secure items can fall; e.g., large pictures, especially if fixed to party walls.

Source: Haber and Nakaki, 1989.

Both physiological and behavioral responses to sonic booms have been examined among California pinnipeds (Manci, et al., 1988). The physiological study demonstrated recognizable short-lived changes in hearing sensitivity as a result of minimum sonic boom overpressures. Longer temporary hearing losses are likely to occur for exposures greater than those tested (Manci, et al., 1988).

Behaviorally, harbor seals, California sea lions, northern fur seals, and Guadalupe fur seals at the Channel Islands would react to sonic booms of any intensity, and many would move rapidly into the water, depending on the season and amplitude of the boom. However, any observed response is usually short in duration. Elephant seals would startle in response to sonic booms of low intensity, but they resume normal behavior within a few minutes of the disturbance (Manci, et al., 1988).

A launch effect of 127.4 dB (108.1 dBA) caused 20 of 23 of the Purisima Point harbor seals to flee into the water, and only 3 returned after 2.5 hours. At Rocky Point, 20 of 74 harbor seals fled into the water during a 103.9-dB (80-dBA) launch event, returning after 30 minutes. Another launch (98.7 to 101.8 dBA) caused almost all Rocky Point harbor seals ashore to flee into the water, after which 75 percent returned within 90 minutes (Tetra Tech, Inc., 1997).

Harbor seals, California sea lions, northern fur seals, and Guadalupe fur seals at the Channel Islands would startle in response to sonic booms of any intensity, and many would move rapidly into the water, depending on the season and amplitude of the boom, but any observed response is usually short-lived. Elephant seals would startle in response to sonic booms of low intensity, but they resume normal behavior within a few minutes of the disturbance (Manci, et al., 1988).

Manatees are relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats (although their hearing is actually similar to that of pinnipeds) (Bullock, et al., 1980). Since manatees spend most of their time below the surface, and since they do not startle readily, no effect of aircraft or launch vehicle overflights on manatees would be expected (Bowles, et al., 1991).

The effect of launch noises on cetaceans appears to be somewhat attenuated by the air/water interface. The cetacean fauna in the area have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc., 1997).

Raptor response to sonic boom while nesting was investigated through the use of simulated booms in natural conditions. Response to sonic boom was fairly minimal (Ellis, 1991). The sonic booms generated for response testing were equivalent to impulse noises generated by supersonic jets in the medium- to high-altitude range (2,000 to 3,000 miles). There was a total of seven raptor species tested, including 84 individuals in various life stages. Of the individuals observed during sonic booms, 65 responses were insignificant. Adult response to the sonic boom usually resulted in flushing from the nest, although incubating or brooding adults never left the nesting area. Reactions among species did have some variation. The reproductive rates for the tested sites were at or above normal for both years of testing. Heart rate response to sonic booms were measured using captive peregrine falcons. Heart rates after sonic booms were at or below a heart rate level of a falcon returning from flight (Ellis, et al., 1991). In a different study on adult peregrine falcons, the startle response was found to cause egg breakage of already thin eggshells (residual

dichlorodiphenyltrichloroethane [DDT] effects) or cause young close to fledgling age to fledge prematurely, thus placing them at a particularly high risk of mortality (Read, 1996a). Peregrine falcons at the early nesting phase are not adversely impacted by Titan IV launches because the chicks are expected to crouch safely down in their nests rather than move toward the edge of the ledge (Read, 1996a).

A huge sooty tern nesting failure that occurred in the southern Florida Dry Tortugas colony in 1969 may have been a result of sonic booms that occurred on a daily basis (Austin, et al., 1970). Birds had been observed to react to sonic booms in previous seasons with a panic flight, circling over the island momentarily, and then usually settling down on their eggs again. Upon review, the nesting failure was attributed more likely to the interruption of the incubation period and from nest abandonment.

3.0 Noise Modeling

3.1 Launch Noise

On-pad and in-flight rocket noise was computed using the RNOISE model (Plotkin, 1997). Rocket noise prediction via this model consists of the following elements:

1. The total sound power output, spectral content, and directivity are based on the in-flight noise model of Sutherland (1993). Noise emission is a function of thrust, nozzle exit gas velocity, nozzle exit diameter, and exhaust gas properties.

   Propagation from the vehicle to the ground accounts for Doppler shift, absorption of sound by the atmosphere (American National Standards Institute, 1978), inverse square law spreading, and attenuation of sound by the ground (Chien and Soroka, 1980). A semi-hard ground surface (1,000 mks rayls) was assumed.

2. One-third spectral levels were computed at the ground, for every flight trajectory point, on a grid of 3,721 points. ASEL and maximum A-weighted and overall sound levels were then derived from the results at each grid point.

   The computed noise levels were then depicted as contours of equal level.

3.2 Sonic Boom

Sonic boom was computed using the U.S. Air Force's PCBoom3 software (Plotkin, 1996). This is a full-ray tracing model. Details of sonic boom theory are presented by Plotkin (1989) and Maglieri and Plotkin (1991). The specific approach to EELV program sonic boom modeling included the following elements:

1. Trajectories provided by the vehicle manufacturers were converted into PCBoom3 TRJ format using PCBoom3's TRAJ2TRJ utility. This utility generated required higher derivatives, as well as converting file formats.

2. Vehicle F-functions were calculated using the method of Carlson (1978). Area distributions were obtained from vehicle drawings. The shape factors computed were used to obtain nominal N-wave F-functions.

3. The F-function associated with the plume was obtained using a combination of the Universal Plume Model (Jarvinen and Hill, 1970) and Tiegerman's (1975) hypersonic boom theory.

4. Ray tracing and signature evolution were computed by integration of the eiconal and Thomas's (1972) wave parameter method.

5. Focal zones were detected from the ray geometry, and focus signatures computed by applying Gill and Seebass's (1975) numerical solution.

The resultant sonic boom calculations were depicted as contours of constant overpressure (psf).

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Appendix V
Cultural Resources: Memorandum of Understanding for EELV Program, Vandenberg AFB, California

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